

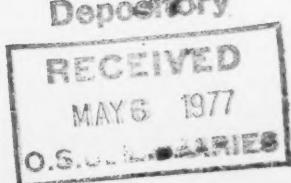
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# SELECTED WATER RESOURCES ABSTRACTS

TC 1  
S45  
V.10  
no. 9



VOLUME 10, NUMBER 9  
MAY 1, 1977



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May-June  
1977

# SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology, U.S. Department of the Interior



**VOLUME 10, NUMBER 9**  
**MAY 1, 1977**

W77-04101 -- W77-04600

The Secretary of the U.S. Department of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Depart-

ment. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1978.

**A**s the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

# FOREWORD

**S**elect Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

**Selected Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstract-

ing, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center  
Office of Water Research and Technology  
U.S. Department of the Interior  
Washington, DC 20240

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### 01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

### 02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

### 03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

### 04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

### 05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

### 06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

### 07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

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### 09 MANPOWER, GRANTS, AND FACILITIES

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## ABSTRACT SOURCES

# SELECTED WATER RESOURCES ABSTRACTS

## 2. WATER CYCLE

### 2A. General

#### ARID BASIN MANAGEMENT MODEL WITH CONCURRENT QUALITY AND FLOW CONSTRAINTS-PHASE II,

Nevada Univ., Reno. Desert Research Inst.

R. L. Bateman, A. B. Cunningham, and T. Ward. Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 454, Price codes: A01 in paper copy, A01 in microfiche. Water Resources Center, Project Report No. 42, February, 1976. 96 p., 14 fig, 10 tab, 29 ref, 4 append. OWRT C-5321(No. 4222)(1).

Descriptors: \*Management, Simulation analysis, Systems analysis, Water quality, \*Model studies, \*Nevada, \*River systems, \*River basins, Water supply, Flow, Hydrologic data, Dendrochronology, Droughts, \*Arid lands.

Identifiers: Sierra Nevada Mountains(Nev), \*Truckee and Carson Rivers(Nev).

A complex river system consisting of two interconnected river basins is being utilized for development of a management model considering quality and flow. The Truckee-Carson system in western Nevada has been the subject of eight years of prior related research which has resulted in a flow management model for the entire system and a chemical quality model for the Truckee River. The on-going research will result in development of a comprehensive water management tool for arid regions where supply and quality demands are varied and often conflicting. Development of a management model for the Truckee-Carson system in which both water supply and quality are considered as bases for developing operating rules has been undertaken. Results are being checked by sampling/analysis of Carson Basin waters to test transferability to other streams along the eastern front of the Sierra Nevada Mountains. Analysis of the statistical properties of annual tree-ring growth, streamflow, and precipitation has been completed. Results show no indication of long-term trends on cyclical climatic behavior in Truckee-Carson region. Hydrologic data series estimated from tree-ring appear to be a good 'first approximation' of historic record especially during periods of drought. (See also W75-00701) (Fallon-Nevada)

W77-04147

#### WATER RESOURCES OF NORTHWESTERN WYOMING,

Geological Survey, Cheyenne, Wyo. Water Resources Div.

E. R. Cox.

Available from Branch of Dist. USGS Box 25286, Federal Ctr. Denver, CO 80225 Price \$4.25. Hydrologic Investigation Atlas HA-558, 1976. 3 sheets, 17 ref.

Descriptors: \*Surface-groundwater relationships, \*Groundwater resources, \*Streamflow, \*Water quality, \*Wyoming, \*Maps, Hydrologic data, Hydrogeology, Water supply, Water utilization, National Parks, Water wells, Springs.

Identifiers: Yellowstone National Park, Grand Teton National Park.

This 3-sheet map report describes the hydrologic conditions in northwestern Wyoming. The increasing number of tourists and residents and the shifting of overnight accommodations for tourists from Yellowstone and Grand Teton National Parks to nearby areas may result in the need for development of additional water supplies in northwestern Wyoming. Hydrologic data have been collected from wells, springs, streams, and lakes in northwestern Wyoming and are given in maps, tables, and graphs. Using streamflow and water-table data, the transmissivity of a segment of an

aquifer in alluvium and glacial outwash in Jackson Hole was estimated to be 30,000 feet squared per day (2,800 meters squared per day). Water in the study area is used for irrigation and for public, domestic, and commercial supplies. (Woodard-USGS)

W77-04238

#### FLOOD STUDIES REPORT.

The Natural Environment Research Council, Institute of Hydrology, Wallingford, Oxon, England, 1975. 1295 p., 24 maps. Price: 45 pound sterling outside U.K., 40 pound sterling within U.K.

Descriptors: \*Floods, \*Flood forecasting, \*Rainfall-runoff relationships, \*Analytical techniques, \*Foreign countries, Hydrologic data, Gaging stations, Peak discharge, Flood discharge, Streamflow, Flow rates, Regression analysis, Mathematical models, Estimating, Equations, Topography, Geology, Meteorological data, Hydrographs, Duration curves, Flood routing, Maps, Evaluation, Planning.

Identifiers: \*Great Britain, \*Ireland.

The 'Flood Studies Report' provides a variety of methods by which the magnitude and frequency of floods may be estimated either at a site with flow records or at an ungauged site and discusses the circumstances under which a particular method of estimation is suitable. The study was based on analysis of data from over 500 British and Irish stations, but the theoretical development and many of the techniques should be valuable to hydrologists and engineers in other countries. The report is presented in five volumes, each dealing with one aspect of the study: Volume I. 'Hydrological Studies' is based on the hydrological studies at the Institute of Hydrology. Volume II. 'Meteorological Studies' describes the work of the Meteorological Office. Volume III. 'Flood Routing Studies' describes the investigations of the Hydraulics Research Station and recommends the choice of a flood routing method based on theory and comparison of several techniques. Volume IV. 'Hydrological Data' presents the basic information which was analysed in the study. Volume V. 'Maps' (24 maps) includes maps of soil and climatic variables, stations used in the analysis, mean annual floods, residuals from mean annual flood prediction equation and rainfall magnitudes of various durations and return periods. (Woodard-USGS)

W77-04244

#### INSTRUMENTATION FOR FIELD STUDIES OF URBAN RUNOFF,

Canada Centre for Inland Waters, Burlington (Ontario).

For primary bibliographic entry see Field 2E.

W77-04246

#### PREDICTING RUNOFF INITIATION TIMES UNDER FIELD CONDITIONS IN TROPICAL (HAWAII) SOILS,

Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.

For primary bibliographic entry see Field 2G.

W77-04252

#### EUSTATIC SEA VARIATION IN THE LAST 2000 YEARS IN THE MEDITERRANEAN,

Bologna Univ. (Italy). Instituto di Fisica.

For primary bibliographic entry see Field 2L.

W77-04271

#### ADJUSTMENT OF MEASURED PRECIPITATION FOR GAGE UNDERCATCH,

State Univ. of New York Coll. at Geneseo. Dept. of Geography.

For primary bibliographic entry see Field 2B.

W77-04274

#### HYDROLOGIC MODELING TO DETERMINE THE EFFECT OF SMALL EARTHEN RESERVOIRS ON EPHEMERAL STREAMFLOW,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 2E.

W77-04320

#### TOWARD AN ANALYTICAL THEORY OF WATER FLOW THROUGH INHOMOGENEOUS POROUS MEDIA,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 2G.

W77-04396

#### EXPERIMENTAL TEST OF THE LANGEVIN EQUATION AS A MODEL FOR WATER FLOW THROUGH UNSATURATED SOIL,

California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.

For primary bibliographic entry see Field 2G.

W77-04397

#### A MARKOVIAN STOCHASTIC BASIS FOR THE TRANSPORT OF WATER THROUGH UNSATURATED SOIL,

Arizona Univ., Tucson. Dept. of Mathematics.

For primary bibliographic entry see Field 2G.

W77-04398

#### ON THE STOCHASTIC FOUNDATIONS OF THE THEORY OF WATER FLOW THROUGH UNSATURATED SOIL,

Arizona Univ., Tucson. Dept. of Mathematics.

For primary bibliographic entry see Field 2G.

W77-04399

## 2B. Precipitation

#### GATE CONVECTION SUBPROGRAM DATA CENTER: SHIPBOARD PRECIPITATION DATA,

National Oceanic and Atmospheric Administration, Washington, D.C. Center for Experiment Design and Data Analysis.

W. R. Seguin, and P. Sabol.

NOAA Technical Report EDS 18, November 1976. 76 p., 3 fig, 51 tab, append.

Descriptors: \*Precipitation(Atmospheric), \*Meteorological data, \*Rainfall, Convection, Data collections.

Identifiers: Eastern North Atlantic Ocean, Marine weather conditions, Global Atlantic Tropical Experiment (GATE), Global Atmospheric Research Program (GARP).

Precipitation amounts at the time resolution they were recorded on shipboard WMO marine logs during the 1974 GARP Atlantic Tropical Experiment (GATE) are presented. Tabulations include both daily amounts and precipitation totals for each of the three observation phases. Tables show rainfall amounts as reported by each ship. Recording frequency varied. Only the time periods for which there was a measurable amount of precipitation are included in the tables. All data were checked against weather observations as recorded in the WMO marine logs to ensure that there was agreement between prevailing weather conditions at the time of reported rainfall. (NOAA)

W77-04196

#### FLOODS IN NEW YORK, 1973 AND 1974,

Geological Survey, Albany, N. Y. Water Resources Div.

For primary bibliographic entry see Field 2E.

W77-04231

## Field 2—WATER CYCLE

### Group 2B—Precipitation

**THE BIG THOMPSON FLOOD OF 1976 IN COLORADO.**  
Geophysical R and D Corp., Fort Collins, Colo.  
For primary bibliographic entry see Field 2E.  
W77-04247

**APPLICATION OF A THREE-DIMENSIONAL MODEL TO COMPUTATIONS OF STORM SURGES IN THE BLACK SEA,**  
B. Kh. Rybak.

Soviet Hydrology, Selected Papers, No. 2, p 89-92, November 1975. 2 fig, 4 ref. Translated from Trudy Gidrometsentral SSSR, No. 119, p 9-17, 1975.

Descriptors: \*Model studies, \*Storm surge, \*Mathematical models, Currents(Water), Water levels, Water level fluctuations, Winds, Foreign countries, Atmospheric pressure, Mathematics, Equations, Limnology, Oceanography.  
Identifiers: \*Black Sea.

The two-dimensional hydrodynamic models of storm surges used until now have several shortcomings that limit their application to deep seas. One limitation concerns the determination of the bottom friction force from average current velocity, which has the disadvantage that the vertical velocity distribution may be very diversified. Bottom currents in deep seas frequently flow in a direction opposite that of surface currents, and, in this case, an error may arise in the determination of the sign of the bottom friction force. Furthermore, the aforementioned models cannot give the vertical distribution of the current vector. Heaps used a three-dimensional model for a rectangular basin. Such a model was used to compute real storm surges in the Black Sea. The scheme was tested using the real storm surge of July 11-13, 1969. The wind was calculated from real atmospheric pressure fields. The pressure fields were taken from synoptic charts at 6-hour intervals. The level and current fields were obtained during the computations. The results were verified from level fluctuations at coastal stations. (Sims-ISWS)  
W77-04260

**ADJUSTMENT OF MEASURED PRECIPITATION FOR GAGE UNDERCATCH,**  
State Univ. of New York Coll. at Genesee. Dept. of Geography.  
R. Lougeay.

Journal of Applied Meteorology, Vol. 15, No. 10, p 1097-1101, October 1976. 1 fig, 3 tab, 19 ref.

Descriptors: \*Rain gages, \*Gages, \*Precipitation(Atmospheric), \*Model studies, \*New York, \*Water balance, Soil moisture, Evapotranspiration, Snowpacks, Rainfall-runoff relationships, Discharge measurement, Instrumentation.  
Identifiers: \*Gage undercatch, Thornthwaite water balance model.

The application of a climatic water balance model was shown to be useful in the estimation of representative regional precipitation. Often the precipitation recording network does not accurately represent the average conditions of a region due to gage height, exposure, and the degree to which the individual sample points represent true variations in precipitation. A comparison of calculated and measured regional runoff was made to assess inaccuracies in the measured hydrologic regime of the study area in western New York State. Discrepancies between calculated and measured runoff were shown to be related to problems of precipitation measurement, producing a consistent gage undercatch. It was shown that a water balance model might be used to adjust regional precipitation values to better represent the average condition over the total region. (Jones-ISWS)  
W77-04274

**STUDIES ON THE RATES OF WATER USE OF DWARF WHEAT AND THEIR RELATIONSHIP WITH POTENTIAL VALUES BASED ON THE CLIMATOLOGICAL APPROACH,**  
Punjab Agricultural Univ., Kapurthala (India). Rice Research Station.

For primary bibliographic entry see Field 3F.  
W77-04314

**FREQUENCY AND PROBABILITY OF DRY SPELLS AT DHARWAR,**  
University of Agriculture Sciences, Bangalore (India). Dharwar Campus.

B. P. Rathnam, D. M. Hegde, and S. N. Joshi. Annals of Arid Zone, Vol. 14, No. 3, p. 201-205, September, 1975. 2 tab, 4 ref.

Descriptors: \*Rainfall, \*Arid lands, \*Weather patterns, \*Frequency, \*Probability, Meteorology, Rain, Precipitation(Atmospheric), Distribution, Distribution patterns, Monsoons, Moisture stress, \*Forecasting, Soil moisture, Crop production, Weather forecasting, Rainfall disposition, Droughts.  
Identifiers: \*Dry spells, \*Dharwar(India).

Prolonged dry spells are a common feature influencing agricultural production. Scientific study of the occurrence of dry spells is, therefore, important for crop planning, particularly in areas that rely upon rainfall rather than irrigation. The frequency of occurrence of dry spells at Dharwar, South India, during the rainy months of June to October was studied, and the probabilities of occurrence of dry spells of different lengths are presented. Twenty-five year daily rainfall records at the Agri-Meteorological Observatory, College of Agriculture, Dharwar, a dry subhumid station, were analyzed. September has the highest frequency of dry spells, while June has the longest average duration. The effect of the occurrence of dry spells on crop production is discussed. (Jamail-Arizona)  
W77-04317

### 2C. Snow, Ice, and Frost

**WATER LOSS FROM SNOWDRIFTS UNDER OASIS CONDITIONS,**  
Wyoming Univ., Laramie. Water Resources Research Inst.

For primary bibliographic entry see Field 3B.  
W77-04174

**RIVER BASIN SNOW MAPPING AT THE NATIONAL ENVIRONMENTAL SATELLITE SERVICE,**  
Massachusetts Inst. of Tech., Cambridge.

National Environmental Satellite Service, Washington, D.C.

S. R. Schneider, D. R. Wiesnet, and M. C. McMillan.

NOAA Technical Memorandum NESS 83, November 1976. 23 p, 10 fig, 1 tab, 17 ref.

Descriptors: \*River basins, \*Snow surveys, \*Mapping, \*Satellites(Artificial), United States, Snow cover, Sensors, Watersheds(Basins), Photography, Data collections.  
Identifiers: Photo-interpretative techniques.

The development of the operational river basin snow mapping program at NESS is described. Satellite derived areal snow cover measurements are now being provided for over 20 river basins to Federal and State agencies around the United States. The snow maps are made, and results are disseminated within 24 hours of a satellite pass over a study basin. The satellite sensors used in snow mapping, the methodology, possible sources of error, and quality control techniques are also described. (NOAA)  
W77-04199

**TERRACES AND SHORELINES OF FLORIDA,**  
Geological Survey, Tallahassee, Fla. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04229

**ANTISYMMETRIC STRESS FOR SEA ICE,**  
Geological Survey, Tacoma, Wash. Water Resources Div.

C. H. Ling, and W. J. Campbell. AIDJEX Bulletin No 33, University of Washington, Seattle, Division of Marine Resources, p 77-84, September 1976. 1 fig, 14 ref.

Descriptors: \*Sea ice, \*Oceans, \*Volume, \*Equations, Methodology, \*Stress, Movement, Arctic Ocean, Antarctic Ocean, Aerial photography, Aircraft, Satellites(Artificial).

Equations are described for studying the dynamics of floating ice. Starting with a control volume, the momentum equation and the equation for the angular momentum are derived. The control volume, which comprises several floes, consists of four control surfaces plus the top and bottom control surfaces that coincide with the top and bottom of the floes. The stress has the unit of force per unit length. The important point to consider is that for the Arctic Ocean and parts of the Antarctic ocean, continuum ice can be large. Recent aircraft and satellite data (Campbell et al., 1974, 1975) show that the Beaufort Sea has a significant variation of floe size, with many large floes, up to 60 km in diameter, in the eastern part and much smaller ones in the western part. During recent aircraft flights between Greenland and the North Pole, many large aggregates composed of numerous small and large floes were observed which had dimensions on the order of 100 km. Marko and Thomson (1975) have noted the presence of large-scale, spatially rectilinear leads separated by distances of approximately 100 km through satellite imagery of the ice-covered Canada Basin in the Arctic Ocean. This is further evidence that the sea ice as a continuum has a very large scale. (Woodard-USGS)  
W77-04240

**ESTIMATION OF THE DEPTH OF SOIL FREEZING IN DRAINAGE BASINS IN THE CENTRAL PART OF THE NORTHWESTERN EUROPEAN USSR,**  
For primary bibliographic entry see Field 2G.  
W77-04259

**SNOW AND ICE SURFACES MEASURED BY THE NIMBUS 5 MICROWAVE SPECTROMETER,**  
Massachusetts Inst. of Tech., Cambridge.

National Environmental Satellite Service, Washington, D.C.

K. F. Kunzi, A. D. Fisher, D. H. Staelin, and J. W. Waters.

Journal of Geophysical Research, Vol. 81, No. 27, p 4965-4980, September 20, 1976. 10 fig, 3 tab, 20 ref. NASA NAS-7-100, NASA-21980.

Descriptors: \*Remote sensing, \*Snow cover, \*Ice cover, \*Polar regions, \*Arctic, \*Antarctica, Satellites(Artificial), Cold regions, Ice, Sea ice, Snow, Electrical properties, Microwaves, Model studies, Mathematical models, Mapping, Surveys.  
Identifiers: \*Microwave spectrometers.

The 22.2- and 31.4-GHz channels of the microwave spectrometer on board the Nimbus 5 earth observatory satellite provide information about the global distribution and character of various types of snow and ice. Observations for the winter and summer of 1973 for both polar regions were presented in this paper. Well-defined spectral signatures were found for snow, sea ice, and land ice in Greenland and Antarctica. A simple model with subsurface temperature gradients in a lossy, homogeneous dielectric does not account for the

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## WATER CYCLE—Field 2

### Streamflow and Runoff—Group 2E

observations; internal scattering effects appear to play a dominant role. (Sims-ISWS)  
W77-04270

**MOUNTAIN AND GLACIER TERRAIN STUDY AND RELATED INVESTIGATIONS IN THE JUNEAU ICEFIELD REGION, ALASKA-CANADA,**  
Foundation for Glacier and Environmental Research, Seattle, Wash. Pacific Center  
M. M. Miller.

Available from the National Technical Information Service, Springfield VA 22161 as AD-A019 703, Price codes: A12 in paper copy, A01 in microfiche. Final Report, May 1975. 239 p, 78 fig, 15 tab, 207 ref, 7 append. ARO DA-ARO-D-31-124-71-G120, DA-ARO-D-31-124-72-G193, DA-ARO-D-31-124-73-G185.

Descriptors: \*Glaciers, \*Alaska, \*Canada, \*Arctic, Cold regions, Geomorphology, Mountains, Snow, Ice, Ice cover, Terrain analysis, Geology, Surveys, Pleistocene epoch, Glaciology, Glaciohydrology, Climatology.  
Identifiers: \*Arctic terrains, \*Mountain terrains, Snow and ice terrains.

The reported investigations cover the years 1971-74 on the Juneau Icefield, Alaska (the Taku District), and in the Atlin, British Columbia, region. Significant advantage has been gained by the availability of field data from the Juneau Icefield Research Program since 1946. With the aim being the clarification of the process factor in arctic and mountain terrains, emphasis is on glacial, glaciofluvial, and periglacial landform. Because the effectiveness of process stress is controlled by geologic structure and time, and because this stress represents a force which combines mass and acceleration, the total mass/energy continuum has to be considered. Therefore, attention is paid to energy distribution in the system and to its changes...i.e., the entropy of the terrain being studied. The analyses were made from data in the disciplines of climatology, glaciology, hydrology, geophysics, continuum mechanics, and periglacial and glacial geology. These reported investigations illustrate fundamental principles of terrain evolution. The principles involved not only are important in this part of the sub-arctic, but, also, they are important in regions of the high arctic of North America where so much developmental activity is now centered. (Sims-ISWS)  
W77-04277

### 2D. Evaporation and Transpiration

**WATER LOSS FROM SNOWDRIFTS UNDER OASIS CONDITIONS,**  
Wyoming Univ., Laramie. Water Resources Research Inst.  
For primary bibliographic entry see Field 3B.  
W77-04174

**EFFECT OF EVAPORATION TIME AND TEMPERATURE ON WATER LOSS IN CALCIQUEOUS SOIL,**  
National Research Centre, Cairo (Egypt).  
M. Y. Tayel, and S. Korkor.  
Egyptian Journal of Soil Science, Vol. 14, No. 2, p 217-224, 5 fig, 9 ref.

Descriptors: \*Water loss, \*Evaporation, \*Calcareous soils, \*Evaporation control, \*Thermal capacity, Soil moisture, Soil surfaces, Capillary water, Soil properties, Water shortage, Moisture content, Soil types, Soil water, Moisture deficit, Drying, Soil water movement, Moisture content, Temperature, Thermal properties, Agriculture.

Evaporation accounts for the major part of water loss from agricultural soils. The effect of temperature and time on water loss through evaporation in calcareous soils was studied, laboratory experi-

ments conducted, and the results presented. It is obvious that both time and temperature have a great effect on the cumulative evaporation and its rate. Results show that evaporation increased with time, the relation being linear at 30 to 40 degrees centigrade. Cumulative evaporation increased with temperature, but at 50 degrees centigrade it was equal to and sometimes less than evaporation at 40 degrees centigrade during the last two weeks. The factors causing these results are described in detail. The heat capacity of a soil decreases with water loss and gives the opportunity for more energy falling on the soil surface to transfer deeper in the columns. Thus, the evaporation process extended deeper with increasing time and temperature. (Jamail-Arizona)  
W77-04323

**SOME ASPECTS OF COMPARATIVE LEAF ANATOMY OF SPECIES OF BROMELIACEAE (ACHEMMEA MEXICANA BAKER AND HECHTIA GLOMERATA ZUCC., (IN SPANISH),**  
Costa Rica Univ., San Jose. School of Biology.  
E. M. Flores.  
Rev Biol Trop 23 (1), p 29-52, 1975.

Descriptors: \*Leaves, \*Stomata, \*Adaptation, \*Drought tolerance, \*Moisture uptake, \*Plant physiology, Xerophytes, Environmental effects, Water storage, Absorption, Transpiration, Geotropism.  
Identifiers: Aechmea-mexicana, Bromeliaceae, Hechtia glomerata, Epiphytes, Costa Rica.

The leaf anatomy of 2 Bromeliaceae, H. glomerata Zucc., a terrestrial xerophyte of arid zones and A. mexicana Baker, a tropical moist forest epiphyte, is compared; these species show adaptations to different extremes of adverse environmental conditions as to water uptake. The leaves of A. mexicana have more water storage tissue than those of H. glomerata; on the other hand, H. glomerata is capable of root absorption. In A. mexicana, modified nonfunctional stomata increase transpiration resistance. This species shows more specialized foliar trichomes which permit the uptake of water and possibly of nutrients. The balance between transpiration and absorption rates is regulated in both species by the combined presence of peltate scales and stomata. The degree of adaptation to drought presented by epiphytic species is more complicated than that shown by terrestrial species. Epiphytic plants like A. mexicana may be derived from xerophytic species that have undergone readaptation to a humid climate. The conspicuous negative geotropism in the leaves of A. mexicana causes the formation of basal deposits of water, which play an important functional role in survival.—Copyright 1976, Biological Abstracts, Inc.  
W77-04581

### 2E. Streamflow and Runoff

**SOIL PROPERTIES AS PARAMETERS RELATED TO FLOODING HISTORY: THE INFLUENCE OF LATERAL AND VERTICAL ACCRETION OF FLOODPLAIN DEPOSITS ON SOILS,**  
Cornell Univ., Ithaca, N.Y. Dept. of Agronomy.  
For primary bibliographic entry see Field 2G.  
W77-04107

**ARID BASIN MANAGEMENT MODEL WITH CONCURRENT QUALITY AND FLOW CONSTRAINTS-PHASE II,**  
Nevada Univ., Reno. Desert Research Inst.  
For primary bibliographic entry see Field 2A.  
W77-04147

**AN EXPERIMENTAL INVESTIGATION OF THE RAINFALL ON THE TURBULENCE PROPERTIES OF OVERLAND FLOW,**  
Purdue Univ., Lafayette, Ind. School of Civil Engineering.

H. Shahabian, and J. W. Delleur.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 494, Price codes: A07 in paper copy, A01 in microfiche. Purdue University Water Resources Research Center, Technical Report No. 88, December 1976, 113 p, 29 fig, 7 tab, 50 ref, 2 append. OWRT A-037-IND(1).

Descriptors: \*Soil erosion, \*Overland flow, \*Shear stress, Rainfall, Sheet erosion, Reynolds number, Flow velocity, Turbulent flow.

Identifiers: Spectral density, Autocorrelation function, Autoregressive moving average.

The principal turbulence characteristics of two-dimensional shallow water flow on a smooth boundary with and without rainfall were studied. The mean and fluctuating components of the longitudinal and vertical velocities, and the corresponding Reynolds stress were measured through the depth of the flow and the mean and fluctuating components of the bottom shear stress were obtained by means of a split hot film sensor and a shear stress sensor respectively. The flow conditions investigated were for a base flow of 546 cm<sup>3</sup>/sec without rainfall per foot of width at a depth of 0.678 cm which corresponded to a Reynolds number of 7700. Rains falling at the rate of 12.7 and 25.4 cm/hr on the same base flow were used to estimate the degree of disturbance caused by the rainfall on the internal mechanism of the turbulent flow. The spectral density estimates and autocorrelation functions for each of the shear stresses and of the velocities are calculated and presented. A probabilistic model for sediment erosion, deposition and transport by overland flow is proposed using the probability distribution of the velocity components. (Wiersma-Purdue)  
W77-04177

**OPTIMIZATION MODEL FOR THE DESIGN OF URBAN FLOOD-CONTROL SYSTEMS,**  
Texas Univ. at Austin. Center for Research in Water Resources.  
D. L. Lott.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 490, Price codes: A11 in paper copy, A01 in microfiche. CRWR-141, November 1976. Technical Report, 217 p, 2 tab, 21 fig, 4 append. 52 ref. OWRT B-196-TEX(1). 14-34-0001-6120.

Descriptors: Flood plain insurance, \*Computer programs, Model studies, Control measures, \*Urban drainage, \*Optimization, \*Flood control.

Because of recent urban and suburban application of floodplain management and insurance programs, the establishment of procedures and computer programs useful in the selection and sizing of control measures that limit flow increases due to upstream urban development to tolerable levels is of growing concern to urban planners and consulting engineers. To some extent, urban drainage system components such as detention basins, channels, pipes, etc., act as ponding or storage facilities and, depending upon such factors as location within the basin, controlled area, amount of effective storage, and relative outflow timing, may or may not reduce downstream peak discharges. When more than one drainage component and downstream flow control location exist, direct selection of appropriate least-cost component sizes that prevent downstream increases in peak flow is not possible. Accordingly, a computer program that combines hydrologic simulation and multivariable optimization techniques was developed in an effort to provide engineers with a useful approach to the solution of the urban flood control design problem. The hydrologic simulations are accomplished using techniques of com-

## Field 2—WATER CYCLE

### Group 2E—Streamflow and Runoff

puter program HEC-1, 'Flood Hydrograph Package', developed at the Hydrologic Engineering Center of The Corps of Engineers. Each drainage or storage component is represented by a parametric storage-outflow relationship. The multivariable cost-minimization routine, a member of a class of nonlinear programming techniques known as methods of feasible directions, exercises the hydrologic simulation routine with various magnitudes of each storage-outflow parameter to determine control component combinations of successively decreasing cost that limit downstream flows to target levels. The univariate gradient search technique is used to arrive at a feasible solution (all flows less than target levels) if the initial solution is infeasible.

W77-04179

**FLOODS IN NEW YORK, 1973 AND 1974,**  
Geological Survey, Albany, N. Y. Water Resources Div.  
F. L. Robison, W. N. Embree, and B. Dunn.  
New York State Department of Environmental Conservation, Albany, Report of Investigation RI-15, 1976. 81 p, 13 fig, 4 tab, 5 ref.

Descriptors: \*Floods, \*Flood damage, \*Flood data, \*New York, Storms, Rainfall, Streamflow, Flow rates, Peak discharge, Winds, Lake Ontario, Shores.

Widespread floods and flood damage that occurred in New York State during calendar years 1973 and 1974 are described. The greatest damage in 1973 was caused by lakeshore flooding of Lake Ontario on March 18 and 19 and by heavy rainfall in the eastern and southeastern regions June 28-30. Gale-force winds on Lake Ontario created waves that caused considerable shoreline damage from Niagara County to Jefferson County on March 18 and 19, 1973. On June 28-30, 1973, heavy rainfall drenched Sullivan and Delaware Counties and caused the most serious flooding since 1947. Rainfall averaged between 4 and 7 inches. At Claverack, in Columbia County, Claverack Creek had the highest discharge of record, 4,960 cubic feet per second on June 30. Thunderstorms July 2 and 3, 1974 caused much flooding from the eastern Finger Lakes through the Mohawk River to the Schoharie Valley. Rainfall exceeded 4 inches in 12 hours at many reporting stations. Considerable flooding occurred in Syracuse, Utica, and other communities in Onondaga and Oneida Counties. On July 3, 1974, a series of brief, violent storms occurred in Columbia County. About 4 inches of rainfall caused as much flooding and damage as in the flood of June 1972. Minor floods within the State are reported by region for each year. (Woodard-USGS)

W77-04231

**WATER RESOURCES OF NORTHWESTERN WYOMING,**  
Geological Survey, Cheyenne, Wyo. Water Resources Div.  
For primary bibliographic entry see Field 2A.  
W77-04238

**TIME OF TRAVEL OF SOLUTES IN MISSISSIPPI RIVER FROM THE ARKANSAS-LOUISIANA STATE LINE TO PLAQUEMINE, LOUISIANA,**  
Geological Survey, Baton Rouge, La. Water Resources Div.  
For primary bibliographic entry see Field 5B.  
W77-04241

**FLOOD STUDIES REPORT.**  
For primary bibliographic entry see Field 2A.  
W77-04244

**INSTRUMENTATION FOR FIELD STUDIES OF URBAN RUNOFF,**  
Canada Centre for Inland Waters, Burlington (Ontario).

J. Marsalek.

Research Program for the Abatement of Municipal Pollution Within the Provisions of the Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 42. 82 p, 25 fig, 7 tab, 2 append.

Descriptors: \*Urban runoff, \*Precipitation(Atmospheric), \*Water quality, \*Sewers, \*Sampling, \*Analytical techniques, \*Instrumentation, \*Measuring instruments, \*Precipitation gages, \*Flow meters, \*Data collection, \*Water measurement, \*Weirs, \*Flumes, Runoff, Hydrographs, Meters, \*Canada.

Identifiers: \*U.S. Geological Survey Sewer Flowmeter, Palmer-Bowlus Flume-Flume layout, Constriction flow meters, Trapezoidal weirs, Areal distribution of precipitation, Point precipitation.

The Hydraulics Research Division of the Canada Centre for Inland Waters tested selected instruments designed to collect data, used in urban runoff studies, which monitor precipitation, runoff quantity and quality (by sampling). The types of instruments studied are recording precipitation gages, sewer flow measurement instruments and automatic wastewater samplers. Point precipitation and the areal distribution of precipitation data can be obtained from a network of recording rain gages installed within the study area. A tipping bucket rain gage (0.01 in) is recommended with a time resolution of 5 minutes or better. Runoff flow rates, recorded continuously at one or more points, should be measured at the outfall, outside the sewer system. Constriction flow meters such as weirs or flumes are suitable. To measure flow inside surcharged sewer pipes, a dual free pressure flow meter such as the U.S. Geological Survey Sewer Flowmeter or an acoustic flow meter should be used; for a pipe not frequently surcharged, a trapezoidal weir without the bottom part or a flume, such as the Palmer-Bowlus layout, is appropriate. Accuracy of runoff flow measurements must be 5-10%. Laboratory analysis of samples collected sequentially by automatic samplers at intervals as short as 5-10 minutes is used to determine runoff quality. Samples should be about 1000 ml in size. To avoid errors in sampling, the sampler intake should be located at a cross section, and the capability of the sampling device to collect solids should be known. (Gentry-NC)

W77-04246

**THE BIG THOMPSON FLOOD OF 1976 IN COLORADO,**  
Geophysical R and D Corp., Fort Collins, Colo.  
J. F. Henz, V. R. Scheetz, and D. O. Doehring.  
Weatherwise, Vol. 29, No. 6, p 278-285, December 1976. 10 fig, 1 tab.

Descriptors: \*Flash floods, \*Rocky Mountain region, \*Disaster, \*Colorado, \*Thunderstorms, Floods, Flood damage, On-site data collections, On-site investigations, Evaluation, Precipitation(Atmospheric), Storm structure, Meteorology, Air masses, Rainfall, Rainfall disposition, Rivers, Discharge(Water), Peak discharge, Flood data. Identifiers: \*Big Thompson River(Colo).

The Big Thompson flood of 31 July 1976 was one of the most costly flash floods in terms of both lives and property damage ever to occur in Colorado and the Western United States. The storm cost 139 lives, with five persons still missing in mid-October, and an estimated \$28.8 million in damage. In the Big Thompson Canyon alone, 316 homes were totally destroyed and 73 received major damage; 56 mobile homes were lost and 52 businesses destroyed. The maximum discharge was estimated at 31,200 cfs. Flood depths are thought to have exceeded 20 feet at some locales, and velocities greater than 25 feet per second are a certainty. Flow in the steeper tributaries may have been as high as 45 feet per second. Some local rainfall totals for the storm included Rist Canyon 7.40 in; Bighorn Canyon (Saturday only) 1.10 in; CSU Foothills Campus 1.40 in; Poudre Park 3.40

in; Loveland 0.12 in; and Horsetooth Heights 2.10 in. Rainbucket surveys indicated a peak point rainfall of 14 in northwest of the Glen Haven area. The thunderstorm system producing the flood rains towered over 60,000 ft in height and remained nearly stationary over the Big Thompson Canyon for four hours, 1830-2230. (Humphreys-ISWS) W77-04247

**MANNING'S ROUGHNESS FOR ARTIFICIAL GRASSES,**  
Ecole Polytechnique Federale de Lausanne (Switzerland). Laboratoire d'Hydraulique.  
For primary bibliographic entry see Field 4A.  
W77-04255

**MORPHOMETRY AND FLOODS IN SMALL DRAINAGE BASINS SUBJECT TO DIVERSE HYDROGEOMORPHIC CONTROLS,**  
Texas Univ., Austin. Dept. of Geological Sciences.

P. C. Patton, and V. R. Baker.  
Water Resources Research, Vol. 12, No. 5, p 941-952, October 1976. 7 fig, 12 tab, 46 ref. NWS A-35460, NASA NAS 9-13312.

Descriptors: \*Texas, \*Watersheds(Basins), \*Geomorphology, \*Floods, Drainage area, Geologic control, Drainage density, Drainage patterns(Geologic), Drainage systems, Hydrology, Flood peak. Identifiers: \*Morphometry, Small drainage basin, Flood response.

Morphometric parameters, such as drainage density, stream magnitude, and relief ratio, are practical measures of flood potential in small (less than 100 sq mi) drainage basins. Stereoscopic interpretation of low-altitude aerial photographs provides the most accurate maps of basins for generating these parameters. Field surveys of a high-density limestone basin in central Texas showed that 1:24,000 scale topographic maps accurately portray the efficient stream channel system but fail to reveal numerous small gullies that may form portions of hillslope hydrologic systems. Flood potential in drainage basins can be defined by a regional index computed as the standard deviations of the logarithms of the annual maximum streamflows. High potential basins tend toward greater relief, greater drainage density, and, thus, greater ruggedness numbers than low-flash flood potential watersheds. For a given number of first-order channels (basin magnitude), flash flood regions have greater ruggedness numbers, indicating higher drainage densities combined with steep hillslopes and stream channel gradients. Transient controls on flood response, such as differences between local rainstorm intensities, appear to be the major influences on hydrographs in areas of moderate dissection and relief. Morphometric parameters for low-potential flash flood regions (Indiana and the Appalachian Plateau) are better estimators of frequent low-magnitude runoff events (mean annual flood), while the same parameters correlate better with the maximum flood of record in high-flood potential regions (central Texas, southern California, and north central Utah). (Lee-ISWS) W77-04265

**SINEPOWER PROBABILITY DENSITY FUNCTION,**  
Institute of Hydraulics and Hydrology, Poondi (India).  
P. Kumaraswamy.  
Journal of Hydrology, Vol. 31, No. 1/2, p 181-184, September 1976. 1 fig, 1 tab, 2 ref.

Descriptors: \*Probability, \*Distribution, \*Statistics, \*Mathematical models, Hydrologic data, Numerical analysis, Frequency, Mathematical studies, Equations. Identifiers: \*Probability density function, Modal value.

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HYDRA THE E VOIRS, Arizona Water C. J. L. Master 36 ref.

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A sinepower probability density function was developed to fit data which are bounded on both the lower and upper sides and which exhibit a single mode of occurrence within the data range. A cumulative distribution function was derived, and a numerical example was presented, showing the evaluation of distribution parameters from the minimum, maximum, and mode of the observed data set. The distribution function has two parameters. (Singh-ISWS)  
W77-04276

**INVESTIGATION INTO METHODS FOR DEVELOPING A PHYSICAL ANALYSIS FOR EVALUATING INSTREAM FLOW NEEDS,**  
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.  
J. F. Orsburn, and F. D. Deane.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 500, Price codes: A06 paper copy, A01 in microfiche. Completion Report, September 15, 1976. 112 p., 41 fig., 21 tab., 69 ref. OWRT A-084-WASH(1), 14-31-0001-6050.

Descriptors: \*Hydrology, Watershed management, Channel flow, Low flows, \*Methodology, \*Evaluation, \*Flow characteristics, Fisheries, Management.

Identifiers: Instream flow, Incremental analysis, Minimum flows.

Numerous disciplines have been working for many years to develop methods whereby the needs of instream uses such as fisheries, recreation, and wildlife can be evaluated in terms of incremental reduction in available stream flow. A basic problem has been the lack of capability to quantify relationships in terms other than primary, such as habitat versus discharge. This report presents a sample of such methodologies, places them in the context of the total watershed, river channel, and stream flow system, and develops a 'severity factor' method for quantifying flow reduction effects in terms of the physical system. Fisheries literature is used as the data source to test and confirm the 'severity factor' method. This report has been prepared with water resource managers in mind as primary users of this information.  
W77-04296

**HYDROLOGIC MODELING TO DETERMINE THE EFFECT OF SMALL EARTHEN RESERVOIRS ON EPHEMERAL STREAMFLOW,**  
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

C. J. Lovely.  
Master of Science Thesis, 1976. 49 p., 10 fig., 7 tab., 36 ref.

Descriptors: \*Reservoirs, \*Streamflow, \*Ephemeral streams, \*Stock water, \*Watershed management, \*Simulation analysis, Watersheds(Basins), Water storage, Runoff, Water demand, Water supply, \*Arizona, Storage tanks, Evaporation, Seepage, Livestock, Drainage systems, Ponds, Water sources, Intermittent streams, Hydrologic data.

Small earthen reservoirs, usually constructed at the headwaters of small tributary watersheds and designed to provide livestock with drinking water, have the effect of preventing water from flowing downstream. The waters trapped are also subject to losses from seepage and evaporation. A study was conducted in Central Arizona to determine the effect of a large number of earthen reservoirs on streamflow in ephemeral channels. A hydrologic watershed model developed by the U.S. Department of Agriculture was utilized. Results indicate that during the winter and spring, when the majority of runoff occurs, streamflow at the mouth of the watershed was reduced 2.6 to 10.7 percent for the four years studied. These results are consistent with the results of previous research on other watersheds in which reductions in streamflow due

to small reservoirs ranged from 2 to 33 percent. The watershed model, as used in this study, was unable to adequately simulate runoff in low water yield years and during the summer runoff season. The model worked well in simulating the winter and spring runoff periods. Based on the findings of other studies, it did a reasonably good job in evaluating the effects of the reservoirs on streamflow. (Jainal-Arizona)  
W77-04320

**2F. Groundwater**

**APPLICATION OF ENVIRONMENTAL TRITIUM IN THE MEASUREMENT OF RECHARGE AND AQUIFER PARAMETERS IN A SEMI-ARID LIMESTONE TERRAIN,**  
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.

G. W. Gross, R. N. Hoy, and C. J. Duffy.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 289, Price codes: A10 in paper copy, A01 in microfiche.

New Mexico Water Resources Research Institute, Las Cruces, Report No. 080, November 1976. 212 p., 26 fig., 5 tab., 17 ref., 4 append. OWRT B-041-NMEX(1), 14-31-0001-4107.

Descriptors: \*Groundwater, \*Recharge, \*Tritium, \*Hydrologic budget, Groundwater recharge, Natural recharge, Groundwater mining, Overdraft, Surface-groundwater relationships, Limestones, \*Artesian aquifers, Saline water intrusion, Hydraulic models, Model studies, Radioisotope, Rainfall-runoff relationships, \*New Mexico, \*Base flow.

Identifiers: Roswell Basin(NM), Artesia(NM).

This project is part of a continuing inquiry into regional patterns of recharge and groundwater flow. Starting from the Hydrologic Model established in a previous investigation, (See W73-06022) this phase has concentrated on determinations of environmental tritium in the basin's Recharge Belt.

Special attention was given to the southern part of the study area where tritium peaks predicted by the Model apparently had failed to materialize. For the sampled wells, all available information on depth and geologic character of water-bearing horizons, as well as construction and history of each well have been collected and summarized. The areal precipitation over the basin has been recomputed for the years 1955-1974, and statistics on surface runoff have been assembled. Tritium concentrations in groundwater from the Recharge Belt are, on the whole, lower than might be expected from the Model. Also, in considerable parts of the Recharge Belt the groundwater is confined. It is tentatively concluded that a slow recharge component is more important than had been assumed by the Model. Rapid recharge seems to occur along present drainage systems. This requires a re-examination of the sources of recharge, the loci where recharge is preferentially fed into the groundwater system, and the details of the recharge process. The distribution of environmental tritium within the basin itself, both in time and space, suggests that interaquiifer leakage is an important factor in these patterns, not considered in the previous study. (Hain-New Mexico State)

W77-04106

**GROUND WATER RESOURCES OF THE BEDROCK AQUIFERS OF THE DENVER BASIN COLORADO,**  
Colorado Dept. of Natural Resources, Denver. Div. of Water Resources, Planning and Investigations.

J. C. Romero.  
1976. p 109, 12 plates, 28 fig., 7 tab., 66 ref., 2 append.

Descriptors: \*Aquifers, \*Groundwater basins, \*Water wells, Water level, Water level fluctuations, Water quality, Groundwater management.

Water measurement, Electrical well logging, Geologic formations, Sampling, Hydrogen sulfide, Methane, Iron, Fluorides, Sodium, \*Colorado.

Identifiers: \*Denver Basin, South Platte River corridor, Strasburg-Byers-Deer Trail area, Laramie formation, Laramie-Fox Hill aquifer.

The bedrock aquifers of the Denver Basin contain vast quantities of groundwater suitable, in most localities, for all beneficial purposes. The major problems which will confront both administrators and users of this groundwater include those associated with declining water levels and deterioration of water quality. Areas in which current water level declines are rapid enough to cause concern are the South Platte River corridor, the Strasburg-Byers-Deer Trail area, and parts of metropolitan Denver. Water quality problems of the Denver Basin's bedrock aquifers are confined predominantly to the Laramie Formation and Laramie-Fox Hill aquifer. Water from these units is locally known to contain troublesome amounts of hydrogen sulfide, methane, iron, fluoride and sodium. Many of these problems can probably be eliminated by avoiding multi-aquifer completions, particularly in the case of mixing Laramie-Fox Hill aquifer water with Dawson Group water. Successful management of the Denver Basin bedrock aquifers will require the collection and utilization of additional data. The importance of additional electric logs, geologic sample logs and aquifer test data cannot be over-emphasized. Also of major importance are water quality testing, an observation well network and accurate measurements of water withdrawn from the aquifer. If managed with caution, the basin can supply the water needs of several generations. (Heiss-NWWA)  
W77-04126

**A NOTE ON AN IN SITU GROUNDWATER SAMPLING PROCEDURE,**

Nebraska Univ., Lincoln. Div. of Natural Resources, Conservation and Survey.  
For primary bibliographic entry see Field 5A.  
W77-04127

**HYDROGEOLOGIC STUDY, NEW HORIZONS SUBDIVISION, CARROLL COUNTY, MARYLAND,**

Maryland Dept. of Natural Resources, Annapolis. Water Resources Administration.  
For primary bibliographic entry see Field 4B.  
W77-04140

**GROUND-WATER RESOURCES OF THE WHITE RIVER JUNCTION AREA, VERMONT,**  
Geological Survey, Montpelier, Vt. Water Resources Div.

For primary bibliographic entry see Field 4B.  
W77-04221

**GROUND-WATER RESOURCES OF THE BARRE-MONTPELIER AREA, VERMONT,**  
Geological Survey, Montpelier, Vt. Water Resources Div.

For primary bibliographic entry see Field 4B.  
W77-04222

**BASEMENT FLOODING AND FOUNDATION DAMAGE FROM WATER-TABLE RISE IN THE EAST NEW YORK SECTION OF BROOKLYN, LONG ISLAND, NEW YORK,**  
Geological Survey, Mineola, N.Y. Water Resources Div.

For primary bibliographic entry see Field 4B.  
W77-04227

**TERRACES AND SHORELINES OF FLORIDA,**  
Geological Survey, Tallahassee, Fla. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04229

## Field 2—WATER CYCLE

### Group 2F—Groundwater

**GEOHYDROLOGIC MAPS OF THE POTOMAC-RARITAN-MAGOOTHY AQUIFER SYSTEM IN THE NEW JERSEY COASTAL PLAIN,**  
Geological Survey, Trenton, N. J. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04234

**WATER RESOURCES OF NORTHWESTERN WYOMING,**  
Geological Survey, Cheyenne, Wyo. Water Resources Div.  
For primary bibliographic entry see Field 2A.  
W77-04238

**GEOLOGY AND GROUND-WATER RESOURCES OF NORTHERN MERCER COUNTY, PENNSYLVANIA,**  
Geological Survey, Harrisburg, Pa. Water Resources Div.  
G. R. Schiner, and G. E. Kimmel.  
Pennsylvania Geological Survey, Harrisburg, Fourth Series, Water Resources Report 33, 1976. 136 p., 12 fig., 8 plates, 4 tab., 43 ref.

Descriptors: \*Groundwater resources, \*Hydrogeology, \*Aquifer characteristics, \*Water quality, \*Geologic mapping, \*Pennsylvania, Water wells, Well data, Water yield, Water utilization.  
Identifiers: Mercer County(Pa).

The Shenango and Stoneboro 15-minute quadrangles are about 60 miles north of Pittsburgh, Pa. These two quadrangles comprise the following 7.5 minute quadrangles: Greenville West, Greenville East, Sharpsville, Fredonia, Hadley, New Lebanon, Jackson Center, and Sandy Lake. The land surface of the area is a maturely dissected plateau covered almost entirely by glacial deposits of the Kent ice sheet (Wisconsin Stage). The glacial deposits range in thickness from 0 to as much as 400 feet. The bedrock is mapped in detail and consists of rocks of Devonian, Mississippian, and Pennsylvanian age. The rocks of Devonian age are not exposed in the area but are present beneath the glacial deposits in deep bedrock valleys. The Mississippian rocks are found along valley sides and some valley bottoms, and the Pennsylvanian rocks generally underlie the uplands. Maximum yields of bedrock wells seldom exceed 100 gpm (gallons per minute), but a yield of 300 gpm is reported from one well in the lower member of the Shenango Formation. Potable water can be obtained everywhere in the area. (Woodard-USGS)  
W77-04239

**STEADY NON-DARCIAN SEEPAGE THROUGH EMBANKMENTS,**  
Punjab Agricultural Univ., Ludhiana (India), Dept. of Civil Engineering.  
P. Basak.

Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 102, No. IR4, Proceedings Paper No. 12623, p 435-443, December 1976. 5 fig, 2 tab, 19 ref.

Descriptors: \*Darcys law, \*Discharge(Water), \*Free surfaces, \*Seepage, \*Aquifer characteristics, Drainage, Water table, Steady flow, Velocity, Analysis, Flow resistance, Porous media, Reynolds number.  
Identifiers: \*Forchheimer equation, Free flow, Non-linear flow resistance.

A steady-state analytical solution for the case of unconfined flow through embankments incorporating Forchheimer's nonlinear velocity-gradient response was presented. The effect of nonlinearity on the discharge characteristics and drawdown distribution in relation to the corresponding Darcian case was brought out. Predicted discharge by means of the derived analytical solution was compared with the available finite difference solution and experimental results. (Adams-ISWS)  
W77-04256

**PROSPECTS FOR USING GROUND WATER IN THE KAZAKH SSR,**  
For primary bibliographic entry see Field 4B.  
W77-04262

**MODEL-FREE STATISTICAL METHODS FOR WATER TABLE PREDICTION,**  
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.  
For primary bibliographic entry see Field 4B.  
W77-04264

**LAND SUBSIDENCE COSTS IN THE HOUSTON-BAYTOWN AREA OF TEXAS,**  
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.  
L. L. Jones, and J. P. Warren.  
Technical Article No. 11447, Texas Agricultural Station, (reprint) American Water Works Association Journal, Vol. 68, No. 11, p 597-599, November, 1976. 1 tab, 9 ref.

Descriptors: \*Land subsidence, \*Groundwater, \*Pumping, \*Water costs, Flooding, Flood damage, Economic impact, Model studies, Water requirements, Surface water, \*Texas.  
Identifiers: \*Ground water pumping induced land subsidence, \*Cost minimization model, \*Houston-Baytown area(Tex).

The physical effects of land subsidence due to groundwater pumping are dependent on location. Most costs and losses associated with subsidence were found to be indirect, caused by either temporary or permanent tidal or freshwater flooding. Areas which suffered flooding due to subsidence of 6 feet or more incurred average annual costs, including both public and private damage and property loss, of 14.6 million dollars (estimated). It was found that if subsidence occurs, groundwater costs, including external costs, exceed the higher direct costs of surface water. Total costs of water for the area are minimized by not permitting ground water withdrawal beyond the point where subsidence begins to occur. The substitution of surface water for groundwater however, would result in higher direct costs to users, and initially, some inducement may be needed to encourage consumption of surface water. (Heiss-NWWA)  
W77-04280

## 2G. Water In Soils

**SOIL PROPERTIES AS PARAMETERS RELATED TO FLOODING HISTORY; THE INFLUENCE OF LATERAL AND VERTICAL ACCRETION OF FLOODPLAIN DEPOSITS ON SOILS,**  
Cornell Univ., Ithaca, N.Y. Dept. of Agronomy.

R. W. Scully, and R. W. Arnold.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 291, Price codes: A04 in paper copy, A01 in microfiche. Cornell University Center for Environmental Research Technical Research Project Completion Report, December 1976. 46 p., 7 figs., 3 tabs., 31 ref. OWRT A-063-NY(1), 14-31-0001-6033.

Descriptors: Stratigraphy, Soil surveys, \*Soil properties, \*Floods, \*History, \*Flood plains, Alluvium, \*Geomorphology, Topography.  
Identifiers: \*Flood plain soils, \*Alluvial chronology, \*Halocene alluvial stratigraphy.

Geomorphic-soil landscapes are reliable indicators of floodplain environments in the studied areas. Lateral accretion deposits of Holocene age, forming terraces, high bottoms, and low bottoms, are mantled with overbank sediments that bury A horizons of prior soils. These cumulative soils with their zones of organic matter concentration have been forming in vertical accretion sediments throughout the past 3,000 years. Fluvents are common soils in modern alluvium and on low bottoms

and seem to identify floodways. Umbrepts and Ochrepts with fluvic properties are common on high bottoms and are useful indicators of floodplain activity affecting observable soil properties. Flooding of higher landscape positions is known to occur but was not detected in field soil morphology. Subtle topographic and geomorphic relationships determined by this study are not always readily visible on airphotos and cannot consistently be recognized and delineated by current soil survey operations. Systematic floodplain mapping expanding the models developed and at scales larger than 1:15,000 should increase the potential use of soil information relative to flooding interpretations.  
W77-04107

**A NEW STOCHASTIC APPROACH TO FOUNDATIONS OF DETERMINISTIC TRANSPORT EQUATIONS FOR POROUS MEDIA,**  
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

G. Sposito, V. Gupta, and R. Bhattacharya.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 489, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, September 30, 1976. 8 p., 5 ref. OWRT B-046-ARIZ(1), 14-34-0001-6057.

Descriptors: \*Stochastic processes, \*Porous media, \*Markov process, Hydraulic conductivity, Moisture, Diffusivity, \*Soil water movement, Soil moisture, Flow, Unsaturated flow.  
Identifiers: \*Langevin equation, Markovian hypothesis, Neutron-scattering, Molecular relations, Vector matric flux potential, Transport coefficients, Scalar matric flux potential, \*Matric potential.

The primary objective was to derive theoretical relationships between the parameters of the Langevin equation (a molecular model for the flow of water in unsaturated soils) and the transport coefficients e.g., moisture diffusivity and hydraulic conductivity. The existing data on a wide variety of soils were to be used to test the consistency of the Markovian hypothesis on water flow that comes from the Langevin equation. The results for 15 different soils produced two basic conclusions. First, that the Langevin equation and Markovian hypothesis are consistent with soil water data for homogeneous, unsaturated soils throughout the normal field range of water content and second, that the parameters in the equation show a 'universal' behavior for a wide variety of soils if expressed as functions of the matric potential. On the theoretical side, it was shown that the volumetric flux density vector, aside from the component due to gravity, always may be expressed in terms of a scalar and a vector matric flux potential. The vector matric flux potential vanishes identically for a homogeneous and a one-dimensional heterogeneous medium and is of no physical consequence insofar as the flow equation is concerned, regardless of the dimensions of space. The specification of that part of flux density vector contributed by the vector flux potential lies in the law of momentum balance instead of mass balance.  
W77-04143

**RESEARCH PERTAINING TO DETERMINATION OF ATP IN SOILS AND SUBSURFACE FORMATIONS,**  
Robert S. Kerr Environmental Research Lab., Ada, Okla.

For primary bibliographic entry see Field 5A.  
W77-04154

**AMMONIA LOSSES ON UREA FERTILIZATION I. MODEL EXPERIMENTS ON AMMONIA VOLATILIZATION AS INFLUENCED BY SOIL PH VALUE, EXCHANGE CAPACITY,**  
No. 5, 11 ref.

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**TEMPERATURE AND WATER CONTENT, (IN GERMAN),**

Deutsche Akademie der Landwirtschaftswissenschaften zu Berlin, Leipzig (East Germany). Institut fuer Duengungsforschung.

H. Lippold, R. Herber, and I. Foerster.

Arch. Acker. Pflanzenbau Bodenkd 19(9), p 619-630, 1975.

Descriptors: \*Ammonia, \*Ureas, \*Fertilization, Model studies, \*Hydrogen ion concentration, \*Soil properties, Volatilization, \*Incubation, \*Moisture content, Temperature.

Identifiers: \*Soil pH, Exchange capacity.

In incubation experiments, simple relations between the amount of volatilized ammonia and these factors were established by a simple method for direct determination of ammonia losses following the application of fertilizer urea to the soil surface. The negative dependence on the exchange capacity is of great practical importance. This relation can be further defined by the soil pH value. Ammonia losses showed an almost linear decline as the degree of water saturation increased. Incubation temperature affected above all the rate of volatilization, whereas the amount of losses determined by the end of experimentation was influenced slightly. Copyright 1976, Biological Abstracts, Inc.

W77-04208

**COMPARISON OF DRAINAGE EQUATIONS FOR THE GRAVITY DRAINAGE OF STRATIFIED PROFILES,**

Mississippi State Univ., Mississippi State. Dept. of Agronomy.

K. K. Wilson, and F. D. Whisler.

Soil Science Society of America Vol. 40, No. 5, p 631-635, September-October 1976. 3 fig, 3 tab, 10 ref.

Descriptors: \*Drainage, \*Gravity, \*Percolation, \*Equations, Numerical analysis, Model studies, Mathematical models, Unsaturated flow, Soil water, Soils, Computers, Profiles, Sands, Analytical techniques, Soil science, Agriculture.

Identifiers: Stratified profiles.

The output from a computer-based numerical analysis of the gravity drainage of a sand profile through an underlying impeding layer was used as the data for testing the manner in which algebraic equations are capable of describing the stratified drainage process. The comparisons indicated that no single equation is satisfactory in describing the wide range of nonlinear behavior that occurred with eight cases analyzed. However, when specific coefficients determined from a least squares analysis were used in an equation of the Jackson and Whisler type, satisfactory correspondence was achieved. (Sims-ISWS)

W77-04248

**RADIAL MOVEMENT OF SATURATED ZONE UNDER CONSTANT FLUX: THEORY AND APPLICATION TO THE DETERMINATION OF SOIL-WATER DIFFUSIVITY,**

Connecticut Agricultural Experiment Station, New Haven.

B. L. Sawhney, and J.-Y. Parlange.

Soil Science Society of America Journal, Vol. 40, No. 5, p 635-639, September-October 1976. 3 fig, 11 ref.

Descriptors: \*Diffusivity, \*Soil water movement, Model studies, \*Laboratory tests, Soils, Soil water, Ponding, Infiltration, Saturated flow, Unsaturated flow, Soil moisture, Simulation analysis, Soil science, Mathematical models.

Identifiers: \*Ponded soils.

A two-dimensional similarity solution yields the soil water diffusivity of an unsaturated soil when the soil water content is measured as a function of the distance from the source. When ponding occurs, the positions of the saturated and unsaturated fronts are related to the diffusivity. If the diffusivity can be described with two parameters, it can be predicted from the position of the two fronts alone without measuring the moisture profile. Four experiments with a fine sandy loam at two different flow rates were performed to determine the diffusivity from the position of the two fronts. The moisture profile was then predicted from the measured diffusivity. The predictions were in good agreement with the observations. (Sims-ISWS)

W77-04249

**EFFECTS OF LIQUID-PHASE ELECTRICAL CONDUCTIVITY, WATER CONTENT, AND SURFACE CONDUCTIVITY ON BULK SOIL ELECTRICAL CONDUCTIVITY,**

Agricultural Research Service, Riverside, Calif. Salinity Lab.

J. D. Rhoades, P. A. C. Raats, and R. J. Prather. Soil Science Society of America Journal, Vol. 40, No. 5, p 651-655, September-October 1976. 7 fig, 3 tab, 13 ref.

Descriptors: \*Electrical conductivity, \*Soils, \*Soil water, Model studies, Laboratory tests, Mathematical models, Salinity, Saline soils, Soil properties, Soil types, Soil science.

Recent research has demonstrated that field soil can be inferred from four-electrode soil electrical conductivity if the soil profile is near 'field capacity' and calibration curves, based on saturation extract salinity, are available. To extend the use of this field method to arbitrary water contents, electrical conductivity was studied in the laboratory as a function of water content and in situ soil water conductivity. Undisturbed cores of four soil types were collected using Lucite column inserts, which were tapped for later insertion of electrodes. The cells were equilibrated with waters of a desired conductivity and, using a pressure membrane apparatus, adjusted to a desired water content. Values of soil electrical conductivity were calculated from measured four-electrode resistances and an appropriate cell constant. A relationship was derived using a simple capillary model, which assumes that liquid phase and surface conductivities (via exchangeable cations) behave as resistors in parallel. (Sims-ISWS)

W77-04250

**EROSION OF SELECTED HAWAII SOILS BY SIMULATED RAINFALL,**

Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.

For primary bibliographic entry see Field 2J.

W77-04251

**PREDICTING RUNOFF INITIATION TIMES UNDER FIELD CONDITIONS IN TROPICAL (HAWAII) SOILS,**

Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.

L. R. Ahuja, E. W. Dangler, and S. A. El-Swaify. Soil Science Society of America Journal, Vol. 40, No. 5, p 777-779, September-October 1976. 1 fig, 1 tab, 10 ref. ARS-USDA 12-14-5001-19, 12-14-5001-40.

Descriptors: \*Runoff, \*Soil types, \*Hawaii, \*Simulated rainfall, Rainfall-runoff relationships, Soils, Infiltration, Ponding, Rainfall, Precipitation(Atmospheric), Surface runoff, Hydraulic conductivity.

Identifiers: \*Runoff initiation times, \*Tropical soils(Hawaii).

Runoff initiation times measured during field rainfall simulation studies on 10 important Hawaii soils were examined in relation to antecedent soil water status. The experimental data showed considerable scatter, which was due mainly to natural soil variability within a soil series. However, the data

exhibited a fairly proportional relationship between runoff initiation time and antecedent soil saturation deficit (final minus initial soil water content), in accordance with a simple Green-Ampt type equation. The results indicated a potential method for estimating erosive portions of rainstorms and subsequent soil loss hazards in relation to varying antecedent soil water contents during different seasons of the year. (Sims-ISWS)

W77-04252

**SURFACE SOIL MOISTURE WITHIN A WATERSHED—VARIATIONS, FACTORS INFLUENCING, AND RELATIONSHIP TO SURFACE RUNOFF,**

Pennsylvania State Univ., University Park.

D. L. Henninger, G. W. Petersen, and E. T. Engman.

Soil Science Society of America Journal, Vol. 40, No. 5, p 773-776, September-October 1976. 2 fig, 4 tab, 16 ref.

Descriptors: \*Soil moisture, \*Watersheds(Basins), \*Pennsylvania, Surveys, Data processing, Soils, Soil types, Precipitation(Atmospheric), Runoff, Evaporation, Vegetation effects, Drainage, Moisture meters, Nuclear moisture meters, Soil science.

Surface soil moisture was measured within the upper 15 cm, using neutron-scattering equipment, on six soil series within a 57.8-ha Pennsylvania watershed during the 19 May to 11 November 1971 period. Surface soil moisture was responsive to individual storm events, showed discernible seasonal trends, and displayed larger fluctuations at higher moisture levels than at lower moisture levels. An analysis of variance showed that well-drained soils had significantly different surface soil moisture levels than the more poorly drained soils. Also, well-drained soils could be grouped into a hydrologic unit distinct from the more poorly drained soils. Surface soil moisture measurements along parallel transects which were approximately perpendicular to the slope contours, showed high surface soil moisture contents proximal to the stream, indicating that these areas contribute more to surface runoff in a shorter period of time than areas distant from the stream channel. Multiple regression equations, using pan evaporation and surface soil moisture for each soil series, were used to show the relative importance of the internal soil drainage class in predicting surface runoff. (Sims-ISWS)

W77-04253

**SOIL WATER DEFICITS UNDER FORESTED AND CLEARCUT AREAS IN NORTHERN ARKANSAS,**

Forest Service (USDA), Fayetteville, Ark. Southern Forest Experiment Station.

T. L. Rogerson.

Soil Science Society of America Journal, Vol. 40, No. 5, p 802-805, September-October 1976. 1 fig, 2 tab, 8 ref.

Descriptors: \*Soil water, \*Vegetative effects, \*Forests, \*Moisture deficit, \*Arkansas, Surveys, Soil moisture, Nuclear moisture meters, Measurement, Evapotranspiration, Soils, Forest soils, Topography, Seasonal, Precipitation(Atmospheric), Rainfall, Vegetation, Streamflow, Runoff, Clear-cutting.

Soil water under forested and cut areas on northwest and southeast aspects was measured with a neutron probe system at weekly intervals in order to study soil water deficit patterns under the mentioned conditions. Soil water deficits were significantly different among years, seasons, and vegetative covers. Summer deficits increased at the average rate of 2.1 mm/day on the forested areas, and 0.6 mm/day on the cut areas. Average seasonal deficits for forested and cut areas, respectively, were: spring, 23 mm and 16 mm; summer, 104 mm and 34 mm; fall, 230 mm and 45

## Field 2—WATER CYCLE

### Group 2G—Water In Soils

mm; and winter, 108 mm and 24 mm. No significant differences were found between soil water deficits on northwest and southeast aspects. (Sims-ISWS) W77-04254

#### ESTIMATION OF THE DEPTH OF SOIL FREEZING IN DRAINAGE BASINS IN THE CENTRAL PART OF THE NORTHWESTERN EUROPEAN USSR,

A. A. Kapotov.

Soviet Hydrology, Selected Papers, No. 2, p 84-88, November 1975. 4 fig, 2 tab, 7 ref. Translated from Trudy Gosudarstvennogo Gidrologicheskogo Instituta, No. 224, p 71-82, 1975.

Descriptors: \*Soil moisture, \*Freezing, \*Watersheds(Basins), On-site investigations, Model studies, Mathematical models, Permeability, Soils, Foreign countries, Land use, Forests, Winter, Runoff, Infiltration, Drainage. Identifiers: \*USSR.

The depth of seasonal soil freezing indicates indirectly the permeability of the upper layers of the zone of aeration and is used in prognostic relations to compute the maximum rates and volumes of spring flood runoff. Available network data on the depth of freezing do not reflect, as a rule, the effect of the existing variety of soils, relief features, land uses, and other factors on the soil freezing regime. Therefore, it is advisable to investigate the aforementioned factors for small index areas or basins, where the effect of individual factors or of their combinations can be identified and where one can determine the possibility of extending the data obtained in them to larger regions. To analyze the dependence of soil freezing depth on its determining factors, a formula was used which was derived on the assumptions that the temperature at the lower freezing boundary is 0°C, that there are no heat fluxes to the freezing boundary from the underlying unfrozen soil layers, and that the freezing process is quasi-stationary at each instant of time. Analysis of the effect of various factors on freezing depth showed that it is possible to use the information on soil freezing depth obtained by the hydrometeorological station network for converting it to basins or their individual parts with different soils, land uses, and relief features. (Sims-ISWS) W77-04259

#### USE OF CASPIAN SEA WATER FOR IRRIGATION,

For primary bibliographic entry see Field 3C.

W77-04263

#### INFLUENCE OF TEMPERATURE REGIMES AND WATER STRESS ON THE GERMINATION OF THREE RANGE GRASSES AND ITS POSSIBLE ECOLOGICAL SIGNIFICANCE TO A SHORTGRASS PRAIRIE,

Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.

For primary bibliographic entry see Field 3F.

W77-04313

#### EROSION CONTROL,

Soil Conservation Service of New South Wales, Cobar (Australia).

For primary bibliographic entry see Field 4D.

W77-04315

#### THE EFFECT OF CULTIVATION ON THE WIND-BORNE SAND SEDIMENTS IN EGYPT,

Cairo Univ., Giza (Egypt). Faculty of Agriculture; and Cairo Univ., Giza (Egypt). Dept. of Soils.

I. Zein El-Abidine, and M. E. El Din Shawky.

Egyptian Journal of Soil Science, Vol. 14, No. 2, p 187-197, 1974. 2 fig, 4 tab, 12 ref.

Descriptors: \*Sedimentation, \*Soil structure, \*Soil profiles, \*Sediment load, \*Sediments, Irrigation, Irrigation water, Land use, Winds, Rivers, Sands, Soil moisture, Moisture content, Quartz, Soil types, Particle size, Particle shape, Porosity. Identifiers: \*Egypt.

Wind-borne sandy sediments form a narrow strip of land running parallel to the western border of the Nile Valley and Delta. They are formed by sedimentation of coarse and fine quartz sands carried by winds blowing from the Western Desert. When these soils were cultivated, a gradual increase in silt and clay was observed. Changes in the structure of the wind-borne sediments were investigated and the particle size analysis, organic matter, and CaCO<sub>3</sub> contents of the layers of studied profiles are presented. Results show a general increase of fine particles and organic matter and a corresponding decrease of sands and CaCO<sub>3</sub> with increasing time of cultivation. These changes are attributed both to sedimentation of fine particles carried by irrigation water and to surface additions of organic manure and plant residues. Determinations of soil moisture characteristics carried out for the investigated profiles show that cultivation, even in its early stages, affects both moisture content and porosity of the soil, the degree depending on duration of cultivation and depth of layers in the profile. The longer the cultivation, the greater the increase in moisture content. This increase is directly related to fine particles and organic matter in the soil layers. The latter components increase the area of water-absorbing surfaces in the soil and cause a change in the size distribution and amount of pores through aggregation. (Jamail-Arizona) W77-04316

#### PLANT SUCCESSION ON THE SAND DUNES OF THE MONTEREY PENINSULA, CALIFORNIA,

California Univ., Berkeley. Dept. of Forestry and Conservation.

For primary bibliographic entry see Field 2I.

W77-04319

#### DESALINATION OF SOILS OF MENOFAYA GOVERNORATE PUT UNDER TILE DRAINAGE,

Ain Shams Univ., Cairo (Egypt). Dept. of Soils; and Ain Shams Univ., Cairo (Egypt). Faculty of Agriculture.

A. El-Leboudi, K. Shaaban, A. H. El-Damaty, and M. M. Ibrahim.

Egyptian Journal of Soil Science, Vol. 14, No. 2, p 167-176, 10 ref.

Descriptors: \*Excess water(Soils), \*Drainage effects, \*Drainage systems, \*Drainage waer, \*Saline water, Desalination, Drainage, Drainage programs, Tiles, Salts, Soil profiles, Arid lands, Semiarid climates, Salinity, Irrigation, Irrigation water, Groundwater, Sodium compounds, Aluvium, Soil types.

The accumulation of excessive amounts of soluble salts in soils is characteristic of arid and semiarid regions due to improper use of irrigation water in the absence of an adequate drainage system. A study was conducted to determine the effect of establishing tile drainage on salinity and the behavior of various ions within certain soil profiles in Egypt. The results are presented in two sections: one dealing with total soluble salts in soil solution and the second concerned with the behavior of various cations and anions under the drainage system studies. The data indicated that tile drainage was relatively more effective in the surface layers of the studied profiles, probably due to the relatively saline underground water. It is recommended that the water table be taken into consideration as well as the depth of tile placement when evaluating the efficiency of a particular drainage system. In general, the data show that tile drainage seemed to have a depressive effect on the concentration of cations and anions. (Jamail-Arizona)

W77-04322

#### EFFECT OF EVAPORATION TIME AND TEMPERATURE ON WATER LOSS IN CALCIAREOUS SOIL,

National Research Centre, Cairo (Egypt).

For primary bibliographic entry see Field 2D.

W77-04323

#### LEACHING OF SALINE SOILS IN MONOLITHS OF IRAQ,

Cairo Univ., Giza (Egypt). Dept. of Soils.

I. M. Habib.

Egyptian Journal of Soil Science, Vol. 14, No. 2, p 149-158, 1974. 3 fig, 2 tab, 20 ref.

Descriptors: \*Saline soils, \*Leaching, \*Irrigation water, \*Soil water movement, \*Salinity, Salts, Field capacity, Drainage, Crop production, Groundwater, Soil water, Physical properties, Irrigation, Soil texture, Soil moisture, Moisture content, Soil surfaces, Salt balance. Identifiers: \*Iraq.

Efficiency of drainage and leaching is recognized as the main cure for soil salinity. Until very recently no artificial drainage facilities existed in Iraq, although total quantity of salts in the crop production areas of Southern and Central Iraq is high. A study was conducted in these areas to establish the magnitude of leaching norms and the relationship between salt discharge by soils and their composition and water physical properties. Six monoliths were taken from different agricultural projects. Salt movement in the different soil layers was followed by installing carbon electrodes. Leaching was conducted using a constant head of ten centimeters of irrigation water. Analyses and water classifications were carried out following methods described by the staff of the U.S. Salinity Laboratory (1954). Results indicate that leaching norms, equal to 2 to 3 times the field capacity, washed out most of the initial salts up to a depth of 1.5 meters. Applying one field capacity more helps in the desalination of heavy, stratified soils as well as in cases of leaching with highly saline water. Salt discharge is affected, mainly during the application of the first portion of leaching norms, by salinity type, depth, and texture of the layer to be leached out. Thus, computing norms should be verified in the field, especially under inadequate drainage conditions. (Jamail-Arizona) W77-04324

#### FACTORS AFFECTING FOREST PRODUCTION ON ORGANIC SOILS,

North Carolina State Univ., Raleigh. Dept. of Forestry.

For primary bibliographic entry see Field 4A.

W77-04387

#### ENTERIC VIRUS REMOVAL FROM SEPTIC TANK EFFLUENT BY PILOT SCALE SOIL ABSORPTION SYSTEMS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.

For primary bibliographic entry see Field 5D.

W77-04389

#### SILVICULTURAL ASPECTS OF FOREST DRAINAGE,

North Carolina State Univ., Raleigh. Dept. of Forestry.

For primary bibliographic entry see Field 4A.

W77-04390

#### TOWARD AN ANALYTICAL THEORY OF WATER FLOW THROUGH INHOMOGENEOUS POROUS MEDIA,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

V. Gupta, G. Sposito, and R. Bhattacharyya.

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## WATER CYCLE—Field 2

### Lakes—Group 2H

1976. 12 p, 10 ref. OWRT B-046-ARIZ(3). 14-34-0001-6057.

Descriptors: \*Porous media, \*Hydraulic conductivity, \*Flow, Equations, Theoretical studies, Soil water movement.

Identifiers: \*Inhomogeneous porous medium, \*Vector matrix flux potential, Law of momentum conservation.

Some rigorous mathematical results on the Buckingham-Darcy flux law for water flow through an isotropic, nondeformable, inhomogeneous porous medium are presented. It is shown that the volumetric flux density vector, aside from the component due to gravity, always may be expressed in terms of a scalar and a vector matrix flux potential. The vector matrix flux potential will vanish for a homogeneous porous medium and for a one-dimensional, inhomogeneous porous medium. It follows from this result that the hydraulic conductivity will be a function only of the water potential in any one-dimensional porous medium if its space derivative at constant water potential vanishes identically. In addition, it is shown that the vector matrix flux potential is of no physical consequence insofar as the flow equation is concerned, regardless of the number of dimensions of space. The specification of that part of the flux density vector contributed by the vector potential appears in the law of momentum balance instead of the law of mass balance.

W77-04398

#### EXPERIMENTAL TEST OF THE LANGEVIN EQUATION AS A MODEL FOR WATER FLOW THROUGH UNSATURATED SOIL

California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.

G. Sposito, P. Sullivan, and V. Gupta.

1976. 17 p, 2 fig, 19 ref. OWRT B-046-ARIZ(6). 14-34-0001-6057.

Descriptors: \*Model studies, \*Unsaturated flow, Equations, Soil moisture, \*Soil water movement, \*Hydraulic conductivity, \*Diffusivity.

Identifiers: \*Richards equation, Soil moisture theory, Statistical mechanics (Water transport).

The parameters that appear in the Langevin Equation, a molecular model for the flow of water through soil, are expressed as functions of the hydraulic conductivity, the water diffusivity, and the soil water matric potential. This permits the parameters to be calculated using available data on the transport properties of homogeneous, unsaturated soils. Since the parameters must have values lying within certain ranges in order that the Langevin Equation and the Markovian hypothesis on water flow that comes from it be applicable, it is possible to test the equation and the hypothesis experimentally. The results for 15 different soils show that: (1) the equation and the Markovian hypothesis are consistent with soil water data for homogeneous, unsaturated soils throughout the normal field range of water content and (2) the molecular parameters in the Langevin Equation show the same behavior for a wide variety of soils when they are expressed as functions of the matric potential.

W77-04397

#### A MARKOVIAN STOCHASTIC BASIS FOR THE TRANSPORT OF WATER THROUGH UNSATURATED SOIL

Arizona Univ., Tucson. Dept. of Mathematics.

R. Bhattacharya, V. Gupta, and G. Sposito.

Soil Science Society of America Journal, Vol 40, No. 3, May-June 1976. 11 ref. OWRT B-046-ARIZ(5). 14-34-0001-6057.

Descriptors: \*Hydraulic conductivity, \*Markov processes, \*Unsaturated flow, Stochastic processes, Equations, \*Soil water movement, Diffusivity, Soil moisture.

Identifiers: Buckingham-Darcy flux law, \*Soil water diffusivity, \*Water flow (Soils).

The differential equation that describes the isothermal, isohaline transport of water through a homogeneous, isotropic, unsaturated soil is shown to result from a fundamental stochastic hypothesis: that the trajectory of a water molecule is a non-homogeneous Markov process characterized by space- and time-dependent coefficients of drift and diffusion. The demonstration makes possible a new theoretical interpretation of the water diffusivity and the hydraulic conductivity at the molecular level and results in a derivation of the Buckingham-Darcy flux law that does not rely directly on experiment.

W77-04398

#### ON THE STOCHASTIC FOUNDATIONS OF THE THEORY OF WATER FLOW THROUGH UNSATURATED SOIL

Arizona Univ., Tucson. Dept. of Mathematics.

R. Bhattacharya, V. Gupta, and G. Sposito.

Water Resources Research, Vol. 12, No. 3, June 1976. 40 ref. OWRT B-046-ARIZ(4). 14-34-0001-6057.

Descriptors: \*Hydraulic conductivity, Diffusivity, \*Soil water movement, Stochastic processes, \*Unsaturated flow, \*Markov processes, Equations, Soil moisture.

Identifiers: \*Buckingham-Darcy flux law, \*Soil water diffusivity, \*Water flow (Soils).

The parabolic differential equation that describes the isothermal isohaline transport of water through an unsaturated soil is shown to be the mathematically rigorous result of a fundamental stochastic hypothesis: that the trajectory of a water molecule is a nonhomogeneous Markov process characterized by space- and time-dependent coefficients of drift and diffusion. The demonstration is valid in general for heterogeneous anisotropic soils and provides for three principal results in the theory of water flow through unsaturated media: (1) a derivation of the Buckingham-Darcy flux law that does not rely directly on experiment, (2) a new theoretical interpretation of the soil water diffusivity and the hydraulic conductivity in molecular terms, and (3) a proof that the soil water diffusivity for anisotropic soil is a symmetric tensor of the second rank. A dynamic argument at the molecular level is developed to show that the fundamental Markovian hypothesis is physically reasonable in the case of water movement through an unsaturated soil.

W77-04399

#### A STUDY OF HABITAT WATER REGIME OF INUNDATED MEADOWS NEAR OSIJEK, (IN CROATIAN)

Agricultural Inst., Osijek (Yugoslavia). Food Science and Technology Inst.

M. Knezevic.

Acta Bot Croat 34, p 81-90, 1975.

Descriptors: \*Habitats, \*Excess water (Soils), \*Grasslands, \*Flood plains, \*Biological communities, Ecology, Soil water, Groundwater.

Identifiers: Carex gracilis, Meadows, Osijek, Plantago altissima, Poa palustris, Serratula tinctoria, Water regime, Yugoslavia, Drava River.

Recent ecological investigations of the meadows on the flood-plain of the River Drava near Osijek (Yugoslavia) show that floristic differences between the communities Serratula tinctoria-Plantago altissima and Carex gracilis-Poa palustris are mainly conditioned by water regime. Differences exist in the amounts of actual and available soil water, in the level of the groundwater, and in the height and duration of inundation to which these meadows are exposed sporadically. Both the actual and available water were relatively greater in the C. gracilis-P. palustris association in the vegetation period. The level of groundwater in this community is higher than in the S. tinctoria-P. altissima association. Water floods the soil surface earlier in the Carectum than in the Plan-

tagetum. Copyright 1976, Biological Abstracts, Inc.

#### PROGNOSIS OF PESTICIDE STABILITY IN WATER, SOIL AND PLANTS, (IN RUSSIAN)

Kievskii Meditsinskii Institut (USSR).

For primary bibliographic entry see Field 5B.

W77-04600

## 2H. Lakes

#### INVESTIGATION TO DETERMINE EXTENT AND NATURE OF NON-POINT SOURCE ENRICHMENT AND HYDROLOGY OF SEVERAL RECREATIONAL LAKES OF EASTERN WASHINGTON, (PART I AND PART II)

Washington State Univ. Pullman. Dept. of Civil and Environmental Engineering.

For primary bibliographic entry see Field 5B.

W77-04103

#### EFFECTS OF HIGH LEVELS OF INORGANIC PHOSPHATE ON AQUATIC ORGANISMS IN PHOSPHATE-RICH ENVIRONMENTS

Georgia Inst. of Tech., Atlanta. School of Biology.

For primary bibliographic entry see Field 5C.

W77-04105

#### SEDIMENT AND RUNOFF MEASUREMENTS FOR A TYPICAL GREAT PLAINS PRAIRIE LAKE

South Dakota State Univ., Brookings. Dept. of Mechanical Engineering.

For primary bibliographic entry see Field 5B.

W77-04108

#### ALGAE ABSTRACTS, A GUIDE TO THE LITERATURE, VOLUME 3, 1972-1974

Office of Water Research and Technology, Washington, D.C. Water Resources Scientific Information Center.

For primary bibliographic entry see Field 5C.

W77-04111

#### EFFECTS OF THERMAL POLLUTION ON CERTAIN AQUATIC INVERTEBRATES

Clemson Univ., S. C. Dept. of Zoology.

For primary bibliographic entry see Field 5C.

W77-04144

#### FIRST REPORT ON THE LIMNOLOGY OF THE ALPINE LAKE LA CALDERA, IN THE PENIBETIC MOUNTAINS (SIERRA NEVADA, GRANADA, SPAIN)

For primary bibliographic entry see Field 5C.

W77-04150

#### THE SIGNIFICANCE OF ALKALINE PHOSPHATASE IN A EUTROPHIC LAKE

For primary bibliographic entry see Field 5C.

W77-04152

#### PROCEEDINGS: BIOSTIMULATION AND NUTRIENT ASSESSMENT WORKSHOP

Pacific Northwest Environmental Research Lab.,

Corvallis, Oreg.

For primary bibliographic entry see Field 5C.

W77-04153

#### ALGAL ASSAYS FOR THE NATIONAL EUTROPHICATION SURVEY

Pacific Northwest Environmental Research Lab.,

Corvallis, Oreg.

For primary bibliographic entry see Field 5A.

W77-04157

## Field 2—WATER CYCLE

### Group 2H—Lakes

**THE USE OF IN SITU ALGAL ASSAYSTO EVALUATE THE EFFECTS OF SEWAGE EF-FLUENTS ON THE PRODUCTION OF SHAGAWA LAKE PHYTOPLANKTON,**  
Pacific Northwest Environmental Research Lab.,  
Corvallis, Ore.  
For primary bibliographic entry see Field 5C.  
W77-04161

**GREAT LAKES NUTRIENT ASSESSMENT,**  
National Environmental Research Center, Grosse  
Ile, Mich. Grosse Ile Lab.  
For primary bibliographic entry see Field 5C.  
W77-04163

**UTILIZATION OF ENERGY BY PRIMARY PRODUCERS IN FOUR PONDS IN NORTHWESTERN FLORIDA,**  
Environmental Protection Agency, Gulf Breeze,  
Fla. Gulf Breeze Environmental Research Lab.  
For primary bibliographic entry see Field 5C.  
W77-04165

**HETEROINHIBITION AS A FACTOR IN ANABAENA FLOS-AQUAE WATERBLOOM PRODUCTION,**  
Environmental Monitoring and Support Lab., Las  
Vegas, Nev.  
For primary bibliographic entry see Field 5C.  
W77-04166

**LEGAL ASPECTS OF LAND USE REGULATION OF LAKE SHORELANDS BY STATE AND LOCAL GOVERNMENTS FOR THE PROTECTION OF LAKES,**  
Texas Univ. at Austin. Center for Research in  
Water Resources.  
For primary bibliographic entry see Field 6E.  
W77-04175

**AN ANALYSIS OF THE INTERNATIONAL GREAT LAKES LEVELS, BOARD REPORT ON REGULATION OF GREAT LAKES WATER LEVELS. SHORELINE PROPERTY AND RECREATION,**  
Wisconsin Univ., Madison. Inst. for Environmental Studies.  
K. Bro, J. Erickson, W. Mode, D. Peterson, and G. Simons.  
Wisconsin University Institute for Environmental Studies, RF Monograph 76-03, IES Working Paper 29, September 1976. 68 p, 13 fig, 16 tab, 30 ref. RF-74099.

Descriptors: Lakes, Recreation, \*Shores, Property values, Beaches, \*Lake shores, Land use, \*Water level fluctuations, Wisconsin, \*Great Lakes.  
Identifiers: \*Lake levels, Coastal zone management.

In analyzing shore property damages associated with lake level regulation plans, the International Great Lakes Levels Board (IGLLB) related water levels to flooding and erosion losses. Water levels (stage)-damage curves were developed which integrated each month's highest water level for May 1951 through April 1952 with the dollar amount of damages which occurred in that year. This was used to estimate the average annual damages which could be attributed to a change in regulation. In evaluating the effect upon recreation of changing the regulation of Great Lakes water levels, the IGLLB addressed recreational beaches, and recreational structures and boating. The IGLLB maintained that the impact of regulation on marinas and boat use would be minimal, while increased beach acreage would provide a substantial portion of the economic benefits from regulations plans. (See also W77-04191) (NOAA)  
W77-04190

**AN ANALYSIS OF THE INTERNATIONAL GREAT LAKES LEVELS, BOARD REPORT ON REGULATION OF GREAT LAKES WATER LEVELS. HYDROLOGY.**  
Wisconsin Univ., Madison. Inst. for Environmental Studies.

J. Knox, C. Falkner, P. Neuman, S. Rettig, and S. Skavronek.  
RF Monograph 76-01; IES Working Paper 27, September 1976. 114 p, 62 fig, 39 tab, 17 ref. RF-74099.

Descriptors: \*Great Lakes, Wisconsin, Hydrologic data, \*Water level fluctuations, Climatic data, Lake Superior, Lake Michigan, Lake Huron, Computer programs.  
Identifiers: Coastal zone management, \*Lake levels.

The regulation of water levels in the Great Lakes is a subject that has recently received much attention by the states directly affected by lake level fluctuations. This report deals with the hydrology of the Great Lakes system and lays the foundation for the subsequent analysis of shore property, navigation, and wetlands. The fluctuations of water levels on the Great Lakes are influenced by natural causes and by structural controls of man. The major natural causes include precipitation, evaporation, runoff, and ground water. The principal man-induced causes relate to the effects of dams and locks and to diversions. A period characterized by water level extremes (very high or very low) is normally accompanied by abundant complaints that artificial controls are the major factors responsible for deviations of levels from the average. This paper and its appendices address problems related to identifying the relative importance of natural and man-induced causes of lake level fluctuations. (See also W77-04190) (NOAA)  
W77-04191

**SHORELINE EROSION AND LANDSLIDES IN THE GREAT LAKES,**  
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.

For primary bibliographic entry see Field 2J.  
W77-04192

**INVENTORY OF LAKE ONTARIO INLETS AND HARBORS: NIAGARA RIVER TO STONY CREEK,**  
State Univ. of New York at Buffalo. Dept. of Civil Engineering.

R. D. Crissman, and J. U. Opara.  
New York Sea Grant Institute Report No. NYSSGP-RS-76-026, December 1976. 266 p, 36 fig, 40 tab, 12 ref, 2 append. NYSS GP-RS-76-026.

Descriptors: \*Recreation facilities, \*Marinas, Water resources, \*Resources development, \*Baseline studies, \*New York, \*Lake Ontario, \*Inlets(Waterways), \*Harbors, Public access.  
Identifiers: Inventories, Launching facilities.

This inventory of Lake Ontario inlets and harbors was conducted to determine the capacities and services of existing boating facilities, to investigate sites for future expansion, and to make recommendations for expansion. Some physical characteristics of Lake Ontario and its use for recreation are presented with a discussion of the historical development of the salmonid fishery and the need for better lake access. The one feature characteristic to nearly all of the inlets, except for the larger tributaries, is a barrier beach. Forty-four of the 61 inlets and harbors inventoried have some type of barrier beach formation. Based on an analysis of the present supply of boating facilities and previous recreational boating demand projections, it is recommended that 3000 additional moorings and/or slips and 50 additional simultaneous launchings be provided by 1980. Recommendations for the distribution of the additional facilities, either by expansion or construction of new facilities throughout the inventory area are

presented. It is suggested the private sector be encouraged to provide marina facilities such as moorings or slips, while the state and municipal governments should be responsible for providing launching facilities. (NOAA)  
W77-04197

**U.S. IFYGL COASTAL CHAIN PROGRAM. REPORT 2: TRANSPORT, CURRENTS AND TEMPERATURE FROM THE UNITED STATES AND CANADIAN IFYGL COASTAL CHAIN STUDIES,**

State Univ. of New York at Albany. Atmospheric Sciences Research Center.  
D. R. Landsberg, and J. T. Scott.  
Report No. 387, August 1976. 228 p, 19 ref. 2-35388; 4-35481; SG-2-35281; 20-S004.

Descriptors: \*Great Lakes, \*Baseline studies, \*Water circulation, \*Meteorological data, \*Currents(Water), \*Water temperature, Water analysis, \*Coasts, \*Lakes, United States, Canada, Transport, Water quality, Winds, Hydrologic data, Environmental effects.  
Identifiers: \*Geostrophic currents, \*Barotropic alongshore currents, Oceanographic data, Coastal waters, Wind stress, Data reports.

This is the second data report from the IFYGL coastal chain program. The first reports provided basic current velocity and temperature data from the Canadian (Csanady and Pade, 1972) and U.S. (Scott, et al 1973) coastal chain programs. The purpose of this data report is to provide a more useful source of the total IFYGL coastal current data than was available in the original data reports. It is intended primarily for the scientific user, but may also provide information on a variety of applied coastal problems. Limnologists are provided with several kinds of summarized temperature, velocity and transport data for the five coastal chains combined. The introductory text provides a review of the measurement techniques including assessment of data accuracy plus the methods of calculation used in the report and the limitations that should be placed on use of the data. (NOAA)  
W77-04198

**FLOODS IN NEW YORK, 1973 AND 1974,**  
Geological Survey, Albany, N. Y. Water Resources Div.  
For primary bibliographic entry see Field 2E.  
W77-04231

**SYMMETRIC FINITE-AMPLITUDE ROTATIONAL WATER WAVES,**  
Delaware Univ., Newark. Dept. of Civil Engineering.

For primary bibliographic entry see Field 2L.  
W77-04266

**COASTAL-TRAPPED WAVES IN A CONTINUOUSLY STRATIFIED OCEAN,**  
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.  
For primary bibliographic entry see Field 2L.  
W77-04267

**NATURAL WATER AND CHEMICAL BUDGETS FOR A SMALL PRECAMBRIAN LAKE BASIN IN CENTRAL CANADA,**  
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.  
For primary bibliographic entry see Field 2K.  
W77-04275

**LAND USE PATTERNS, EUTROPHICATION AND POLLUTION IN SELECTED LAKES,**  
Vermont Univ., Burlington. Dept. of Agricultural and Resources Economics.  
For primary bibliographic entry see Field 5C.  
W77-04298

**PROCESSES OF DISSOLVED OXYGEN DEPLETION IN TIMS. FORD RESERVOIR,**  
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5C.  
W77-04327

**FECONDITY OF COHO SALMON (ONCORHYNCHUS KISUTCH) FROM THE GREAT LAKES AND A COMPARISON WITH OCEAN SALMON,**  
Michigan Dept. of Natural Resources, Marquette.  
T. M. Stauffer.  
Journal of the Fisheries Research Board of Canada, Vol. 33, p. 1150-1155, 1976, 4 fig., 3 tab., 13 ref.

Descriptors: \*Reproduction, \*Salmon, \*Fertility, \*Fecundity, \*Productivity, \*Fish eggs, \*Fish reproduction, \*Great Lakes, \*Anadromous fish, Freshwater fish, Populations, Biological properties, Lake Michigan, Lake Superior, Pacific Ocean.  
Identifiers: \*Coho salmon.

A comparison between fecundity of coho salmon (*Oncorhynchus kisutch*) that matured in the Great Lakes, and Pacific Ocean coho salmon showed a similar number of eggs produced. Average egg diameters of Lake Michigan (7.1-7.4 mm) and Pacific Salmon (6.1-7.4 mm) were also comparable but lake Superior eggs were smaller (5.1-5.4 mm). Fecundity of second generation freshwater salmon which originated from Lake Michigan eggs was similar to that of the first generation which originated from Pacific eggs because the average numbers (2938-3243) and diameters (7.1-7.4) of eggs produced were about the same. On the average, Lake Michigan salmon contained more (2938) and larger (7.1 mm diam) eggs than did Lake Superior salmon (2150 and 5.1 mm diam) of the same year-class and early life history. (Katz)  
W77-04344

**CLEANER: THE LAKE GEORGE MODEL,**  
Rensselaer Polytechnic Inst., Troy, N.Y. Fresh Water Inst.  
For primary bibliographic entry see Field 6G.  
W77-04495

**A DISCUSSION OF CLEAN, THE AQUATIC MODEL OF THE EASTERN DECIDUOUS FOREST BIOME,**  
Tetra Tech, Inc., Lafayette, Calif.  
For primary bibliographic entry see Field 6G.  
W77-04496

**PHOTOPLANKTON MODELS AND EUTROPHICATION PROBLEMS,**  
Manhattan Coll., Bronx, N.Y. Environmental Engineering and Science Program.  
For primary bibliographic entry see Field 5C.  
W77-04499

**THE BEHAVIOR OF PLUTONIUM IN AQUATIC ECOSYSTEMS: A SUMMARY OF STUDIES ON THE GREAT LAKES,**  
Argonne National Lab. Ill. Radiological and Environmental Research Div.  
For primary bibliographic entry see Field 5C.  
W77-04519

**AN EXAMINATION OF THE POSSIBLE EFFECTS OF SUDBURY NICKEL MINING AND SMELTING OPERATIONS ON FISHES AND THE WATER CHEMISTRY OF LAKES WITHIN THE WHITEFISH LAKE INDIAN RESERVE,**  
Fisheries and Marine Service, Nanaimo (British Columbia). Biological Station.  
For primary bibliographic entry see Field 5C.  
W77-04571

**LEVELS OF ARSENIC AND SELENIUM IN THE GREAT LAKES REGION,**  
Canada Centre for Inland Waters, Burlington (Ontario).  
For primary bibliographic entry see Field 5B.  
W77-04574

**EFFECTIVENESS OF SPAWNING OF THE WHITE BREAM BLICCA BJOERKNA (L.) AND ROACH RUTILUS RUTILUS (L.) IN THE UPPER PART OF THE KUIBYSHEV RESERVOIR, (IN RUSSIAN),**  
Kazan State Univ. (USSR). Dept. of Vertebrate Zoology.  
A. M. Kutuzov.  
Vopr Ikhtiol 15(4), p 752-756, 1975.

Descriptors: \*Spawning, \*Fish reproduction, \*Fish populations, \*Ecosystems, Reservoir fisheries, Meteorology, Ecology.  
Identifiers: \*Blicca bjoerkna, Bream, Kuibyshev, Reservoir, Roach, I. Russian SFSR, Rutilus rutilus, USSR, \*White bream.

In years when the spawning of the roach (*R. rutilus*) was especially effective in the upper part of the Kuibyshev reservoir on the Volga (Russian SFSR, USSR) due to favorable hydrometeorological conditions, the conditions for spawning of the white bream (*B. bjoerkna*) were favorable and vice versa. Thus the white bream and roach were able to maintain stocks of small fish in the reservoir at a high level, since only in central years are the hydrometeorological conditions unfavorable for the spawning of both species.—Copyright 1976, Biological Abstracts, Inc.  
W77-04580

**EFFECT OF THE NOVOROSSISK HEAT ELECTRIC POWER STATION WARM WATERS ON ZOOPLANKTON, (IN RUSSIAN),**  
Kuban State Univ., Novorossisk (USSR). Marine Biology Research Station.  
For primary bibliographic entry see Field 5C.  
W77-04583

**PREDICTION OF THE PHYTOPLANKTON DEVELOPMENT IN DESIGNED RESERVOIRS BY COMBINING A GROWTH-MODEL AND THE ANALOGY TO EXISTING RESERVOIRS, (IN GERMAN),**  
Technische Universitaet, Dresden (East Germany).  
For primary bibliographic entry see Field 5C.  
W77-04584

**COMPUTER PROGRAM FOR PRESENTING ACTUAL LAKE DATA, (IN GERMAN),**  
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).  
For primary bibliographic entry see Field 7C.  
W77-04585

**PRIMARY ORGANIC PRODUCTION IN A BRACKISH EUTROPHIC ENVIRONMENT (ETANG DE BERRE): EFFECTS OF STRONG DILUTION (FROM THE WATERS OF THE DURANCE), (IN FRENCH),**  
Centre d'Oceanographie, Marseille (France). Station Marine d'Endoume.  
For primary bibliographic entry see Field 5C.  
W77-04587

**DISCHARGE OF TREATED WASTEWATER IN LAKES, (IN GERMAN),**  
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).  
For primary bibliographic entry see Field 5B.  
W77-04595

## 21. Water In Plants

**RAPID DETECTION OF VARIOUS KINDS OF HERBICIDES IN WATER BY THE IN VIVO DETERMINATION OF NITRATE REDUCTASE ACTIVITY IN LEMNA MINOR, (IN FRENCH),**  
Institut de Recherches Chimiques, Tervuren (Belgium).  
For primary bibliographic entry see Field 5C.  
W77-04261

**INFLUENCE OF TEMPERATURE REGIMES AND WATER STRESS ON THE GERMINATION OF THREE RANGE GRASSES AND ITS POSSIBLE ECOLOGICAL SIGNIFICANCE TO A SHORTGRASS PRAIRIE,**  
Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.  
For primary bibliographic entry see Field 3F.  
W77-04313

**EFFECT OF INDOLE ACETIC ACID PRESOAKING OF SEEDS AND THE QUALITY OF WATER APPLIED ON LEVELS OF AMINO ACIDS IN ARACHIS HYPOGEA,**  
Rajasthan Coll. of Agriculture, Udaipur (India). Dept. of Soil Science and Agricultural Chemistry.  
For primary bibliographic entry see Field 3C.  
W77-04318

**PLANT SUCCESSION ON THE SAND DUNES OF THE MONTEREY PENINSULA, CALIFORNIA,**  
California Univ., Berkeley. Dept. of Forestry and Conservation.  
J. R. McBride, and E. C. Stone.

The American Midland Naturalist, Vol. 96, No. 1, p 118-132, July, 1976. 2 fig., 2 tab., 35 ref.

Descriptors: \*Dunes, \*Dune succession, \*Sands, \*Soil properties, \*Soil moisture, Succession, Plant populations, Vegetation, Acidity, Soils, Soil-water-plant relationships, Soil types, Soil water, Water utilization, Moisture, Moisture stress, Moisture availability, \*California.  
Identifiers: Monterey Peninsula(Calif.).

The sequence of vegetational stages that characterize the successional process on the sand dunes found along the western edge of the Monterey Peninsula was studied. Average annual precipitation at Monterey amounts to 42.5 centimeters and fog is common in the summer. The degree of soil development was determined beneath each successional stage by measurement of particle size distribution, organic carbon, water holding capacity, soil to water ratio, cation exchange capacity, and acidity. The sequence identified was supported by the soil analyses which demonstrated a close correlation between plant succession and soil development. For certain species to become established on the dunes, the moisture holding capacity of the soil would have to be increased and some reduction in evaporative stress be achieved. (Jamaal-Arizona)  
W77-04319

**SILVICULTURAL ASPECTS OF FOREST DRAINAGE,**  
North Carolina State Univ., Raleigh. Dept. of Forestry.  
For primary bibliographic entry see Field 4A.  
W77-04390

**THE EARLY LIFE HISTORY OF FISH, VOLUME II,**  
Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. Springer-Verlag, New York, Edited by J. H. S. Blaxter. 765 p.

## Field 2—WATER CYCLE

### Group 21—Water In Plants

Descriptors: \*Conferences, Publications, \*Life history studies, Fish, Behavior, Systematics, \*Fish farming, Physiological ecology, Feeding rates, Food.

Vol II of the proceedings contains 40 papers in the subject areas of feeding and metabolism (7 papers), physiological ecology (10 papers), developmental events (4 papers), behaviour (4 papers), taxonomy (9 papers), and rearing (6 papers). Also included is a section summing-up the symposium and a subject index. (See W77-04525 thru W77-04556) (Chilton-ORNL) W77-04524

#### MASS REARING OF THE BASS DICENTRARCHUS LABRAX L., Station de Biologie Marine et Lagunaire, Sete (France).

G. Barnabe.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 749-753, 3 fig, 4 ref.

Descriptors: \*Fish farming, Reproduction, Growth stages, Larval growth stage, \*Bass, Foods, Food abundance.

Identifiers: \*Mass rearing(Fish).

After receiving hormone injections, maturing sea bass females were placed in a tank with naturally running males. Viable eggs were spawned which the males fertilized normally. The pelagic eggs above a salinity of 34.5% and a temperature of 15°C were collected and incubated in illuminated still water in which planktonic algae had previously been cultured. Hatching occurred after 70 hours and two days later, the rotifer *Brachionus plicatilis* was introduced into the medium. Best results were obtained with a rearing density of about 5 rotifers/ml. After five days, the density can be reduced to 1/ml. After the 12th day, nauplii of *Artemia salina* can be offered alternately with the rotifers. From the 15th to 35th days *Artemia* were offered alternately with plankton hauls. After this the food consisted of minced fish and crab. (See also W77-04524) (Chilton-ORNL) W77-04525

#### NUTRITION DE LA LARVE DE TURBOT (SCOPHTHALMUS MAXIMUS L.) AVANT LA METAMORPHOSE, Centre Oceanologique de Bretagne, Brest (France).

For primary bibliographic entry see Field 5C.

W77-04526

#### PROGRESS TOWARDS THE DEVELOPMENT OF A SUCCESSFUL REARING TECHNIQUE FOR LARVAE OF THE TURBOT, SCOPHTHALMUS MAXIMUS L., Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.

A. Jones, R. Alderson, and B. R. Howell.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 731-737, 1 tab, x1 fig, 10 ref.

Descriptors: \*Fish farming, Growth, \*Growth stages, Larval growth stage, Larvae, Food abundance.

Identifiers: \*Turbot.

In 1972 turbot larvae were reared beyond metamorphosis for the first time at the Lowestoft and Fort Erin laboratories. The paper described these experiments and discusses ways in which larval survival in future experiments might be improved. It was concluded that although newly metamorphosed turbot may be taken on beaches at certain times of the year it is unlikely that they could be caught in sufficient numbers to support a

commercial farming operation. Results of the present experiments show that turbot can be reared artificially but the optimum conditions, especially the effect of food density and diet on survival, still have to be defined. (See also W77-04524) (Chilton-ORNL) W77-04527

#### LABORATORY REARING OF COMMON SOLE (SOLEA SOLEA L.) UNDER CONTROLLED CONDITIONS AT HIGH DENSITY WITH LOW MORTALITY, Bayerische Landesanstalt fuer Fischerei, Sternberg (West Germany).

For primary bibliographic entry see Field 5C.  
W77-04528

#### ARTIFICIAL INSEMINATION IN TROUT USING A SPERM DILUANT, Institut National de la Recherche Agronomique, Jouy-en-Josas (France). Laboratoire de Physiologie des Poissons.

R. Billard, J. Petit, B. Alabert, and D. Szollosi. In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 715-723, 3 tab, 5 fig, 15 ref.

Descriptors: \*Reproduction, \*Fish reproduction, \*Trout, Salmonids, Fish farming.

Identifiers: \*Artificial insemination, Sperm diluant.

In the practice of artificial insemination in salmonids, efficiency is usually poor since one male is used to fertilize only a few females. The paper describes a new technique of artificial insemination in attempts to improve efficiency. Ova and sperm are mixed together with a diluant simultaneously. Inseminated eggs should be transferred into freshwater in less than 2 min or left in the diluant for 15 min because of an unexplainable drop in fertility occurring when eggs are transferred into water between 2 and 10 min following insemination. Diluant is a saline solution buffer at pH 8.5 to 9.5, and with osmotic pressure varying from 150 to 250 mosmol. Minimum of spermatozoa required for fertilization is about 200 000 per egg. (See also W77-04524) (Chilton-ORNL) W77-04529

#### A COMPARISON OF LARVAE OF THE DEEP-WATER AND FOURHORN SCULPIN, MYOXOCEPHALUS QUADRORNIS L. FROM NORTH AMERICA. I. MORPHOLOGICAL DEVELOPMENT, Ottawa Univ. (Ontario).

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 703-712, 8 fig, 30 ref.

Descriptors: \*Systematics, \*Growth stages, Life history studies, Larvae, Larval growth stage, Fish, Sculpins.

Identifiers: \*Morphological development.

Morphologically similar sculpins live in freshwater lakes and in coastal arctic waters in northern North America. This study was carried out in order to identify differences and similarities among larvae collected from different habitats. Free swimming larvae of deepwater sculpins from the Laurentian Great Lakes and of fourhorn sculpins from the Beaufort Seas were collected with conical plankton nets. The morphological development of larvae collected from these bodies of water are described and illustrated. Differences include pigmentation patterns, number of myomeres and size. Similarities to European species are suggested. (See also W77-04524) (Chilton-ORNL) W77-04530

#### MORPHOLOGICAL STUDIES OF TWO PRISTIGASTERINAE LARVAE FROM SOUTHERN BRAZIL, Sao Paulo Univ. (Brazil). Instituto Oceanografico. Y. Matsuura.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 685-701, 5 tab, 11 fig, 14 ref.

Descriptors: \*Life history studies, \*Systematics, Fish taxonomy, Larvae, Larval growth stage, Growth stages.

Identifiers: Osteology, \*Brazil.

The study is a part of the Sardine Project SOL to investigate the spawning and early life history of the Brazilian sardine and its relatives. Larval developments of two clupeid fishes, *Pellona harroweri* and *Chirocentrodon bleekerianus*, belonging to the subfamily Pristigasterinae are described and figured. The samples were collected in southern Brazil with beam-trawl net. Morphometrical and osteological studies are made and systematic status of *C. bleekerianus* is presented. (See also W77-04524) (Chilton-ORNL) W77-04531

#### LARVAE OF SOME FLAT FISHES FROM A TROPICAL ESTUARY, Cochin Univ. (India). Dept. of Marine Sciences.

For primary bibliographic entry see Field 2L.

W77-04532

#### EARLY LIFE HISTORY OF LIMANDA YOKOHAMAE (GUNTHER), Tohoku Regional Fisheries Research Lab., Shiogama (Japan).

T. Yusa.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 675-676, 2 ref.

Descriptors: \*Systematics, \*Fish taxonomy, \*Life history studies, Fish, Aquaculture, Growth stages.

Identifiers: Metamorphosis, *Limanda yokohamae*.

Potential use of *Limanda yokohamae*, the mud dab, in coastal aquaculture led to investigations on egg and larval development. Egg survival to hatching was found to be 50% at 5°C, 70% at 10°C, and 10% at 15°C. The total body length of newly hatched larvae averaged 3.6 mm. Pigmentation of larvae provides important taxonomic characters. Metamorphosis began about 32 days after hatching at 8°C and was completed after about 18 days. *L. yokohamae* is distinguished from *L. schrenkii* on the basis of an adhesive layer on the outside of the chorion of eggs, the incubation period, and pigmentation. (See also W77-04524) (Chilton-ORNL) W77-04533

#### THE DIVERSE PATTERNS OF METAMORPHOSIS IN GONOSTOMATID FISHES—AN AID TO CLASSIFICATION, National Marine Fisheries Service, La Jolla, Calif. Southwest Fisheries Center.

E. H. Ahlstrom.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 659-674, 2 fig, 2 tab, 22 ref.

Descriptors: \*Systematics, \*Growth stages, Fish, Classification, Fish taxonomy, Life history studies.

Identifiers: \*Gonostomatids, Metamorphosis.

The gonostomatid family of fishes is made up of 20 genera and approximately 60 species. Photophore patterns were used as a primary character in adult taxonomy. The diversity of photophore

## WATER CYCLE—Field 2

### Water In Plants—Group 21

acquisition is used to trace relationships among gonostomatid genera. On the basis of metamorphic patterns, the gonostomatid genera fall into three groups; those in which most or all ventral photophores are laid down initially during a white photophore stage and which have all photophores individually separate; those with a gradual protracted metamorphosis but with all photophores individually separate; and those having some or most photophores in clusters with common bases which are laid down gradually during a protracted metamorphosis. The second group is considered the pivotal genus with developmental patterns that show relationships to the other two groups. (See also W77-04524) (Chilton-ORNL) W77-04534

#### PRESENT STATE OF BILLFISH LARVAL TAXONOMY, Far Seas Fisheries Research Lab. Shimizu (Japan). S. Ueyanagi.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 649-658, 6 fig, 2 tab, 7 ref.

Descriptors: \*Systematics, Larvae, Larval growth stage, Reviews, Fish, Fish taxonomy, Life history studies.

Identifiers: \*Billfish.

The report summarizes recent research on the identification of billfish larvae. Of the two families, the Xiphiidae is monotypic while the Istiophoridae consists of 3 genera and 11 species. Probably the most useful factor for distinguishing the various istiophorid species is identified as being head morphology. Pigmentation is discussed as an important characteristic for identification. (See also W77-04524) (Chilton-ORNL) W77-04535

#### ANALYSIS OF THE TAXONOMIC CHARACTERS OF YOUNG SCOMBRID FISHES, GENUS THUNNUS.

National Marine Fisheries Service, Miami, Fla. Southeast Fisheries Center.

W. J. Richards, and T. Pothoff.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 623-648, 18 tab, 15 ref.

Descriptors: \*Systematics, Fish, Larvae, Larval growth stage, Fish taxonomy.

Identifiers: \*Scombridae, Osteology, Melanophores.

The specific identification of larval scombrids as presented in the paper was based primarily on the distribution of melanophores on various parts of the body. Examination of these pigment distributions revealed a great amount of variability as to the exact location and number of melanophores on larvae in the genus *Thunnus* from the Atlantic Ocean. Specimens from melanophore data were obtained, cleared and stained for study of their osteology and for accurate identification. Results showed that melanophore distributions were unreliable characters for specific identification. This was particularly evident where western Atlantic larvae identified as *T. albacares*, *T. alalunga*, or *T. obesus*, using the traditional melanophore character method, were found to be larvae of *T. atlanticus* based on osteological features. (See also W77-04524) (Chilton-ORNL) W77-04536

#### THE LARVAL TAXONOMY OF THE PRIMITIVE MYCTOPHIFORM FISHES, Japan Sea Regional Fisheries, Research Lab., Niigata. M. Okiyama.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 609-621, 6 fig, 4 tab, 16 ref.

Descriptors: \*Systematics, Fish, Larval growth stage, Larvae, Fish taxonomy.

Identifiers: \*Myctophoidea.

The families treated in the paper are exclusively referable to Myctophoidea with special emphasis placed on Aulopidae and its close relatives. The paper describes unknown larvae, reviews the larval stages of Myctophoidea, and speculates on the possible familial relationships from the larval standpoint. Special emphasis is placed on the peritoneal pigment spots in view of their integrity within Myctophiformes. (See also W77-04524) (Chilton-ONRL) W77-04537

#### THE ROLE OF LARVAL STAGES IN SYSTEMATIC INVESTIGATIONS OF MARINE TELEOSTS: THE MYCTOPHIDAE, A CASE STUDY,

National Marine Fisheries Service, La Jolla, Calif. Southwest Fisheries Center.

H. G. Moser, and E. H. Ahlstrom.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 605-607, 2 ref.

Descriptors: \*Systematics, \*Teleosts, \*Larval growth stage, Larvae, Evolution, Abstracts.

Identifiers: Myctophidae.

Abstract of the paper only is published in this volume with the notation that the paper is published in *Fish. Bull.*, U. S. 72 (2): 391-413, April 1974. Studies of larval stages of Myctophidae are reported to have included samples from all oceans. Studies of the larval lantern fishes disclosed a full range of characteristics from the generalized to specialized and conservative to labile. Categories of these characters include eye shape, head trunk, gut, and fins, especially the pectoral fins. The concluding section of the paper deals with myctophid evolution. (See also W77-04524) (Chilton-ORNL) W77-04538

#### THE ABILITY OF HERRING AND PLAICE LARVAE TO AVOID CONCENTRATIONS OF OIL DISPERSANTS,

Aberdeen Univ. (Scotland). Dept. of Natural History.

For primary bibliographic entry see Field 5C.

W77-04539

CHANGES IN BEHAVIOR DURING STARVATION OF HERRING AND PLAICE LARVAE, Dunstaffnage Marine Research Lab., Oban (Scotland).

For primary bibliographic entry see Field 5C.

W77-04540

#### EFFECT OF PREY DISTRIBUTION AND DENSITY ON THE SEARCHING AND FEEDING BEHAVIOR OF LARVAL ANCHOVY ENGRAULIS MORDAX GIRARD,

National Marine Fisheries Service, La Jolla, Calif. Southwest Fisheries Center.

For primary bibliographic entry see Field 5C.

W77-04541

#### VITAL ACTIVITY PARAMETERS AS RELATED TO THE EARLY LIFE HISTORY OF LARVAL AND POST-LARVAL LAKE WHITEFISH (COREGONUS CLUPEAFORMIS),

Virginia Inst. of Marine Science, Gloucester Point.

For primary bibliographic entry see Field 5C.

W77-04542

GYNOGENESIS IN HYBRIDS WITHIN THE PLEURONECTIDAE, Ministry of Agriculture Fisheries and Food, Lowestoft (England).

For primary bibliographic entry see Field 5C.

W77-04543

#### ARTIFICIAL GYNOGENESIS AND ITS APPLICATION IN GENETICS AND SELECTIVE BREEDING,

Bureau of Sport Fisheries and Wildlife, Stuttgart, Ark. Fish Farming Experiment Station.

For primary bibliographic entry see Field 5C.

W77-04544

#### INFLUENCE OF TEMPERATURE AND SALINITY ON EMBRYONIC DEVELOPMENT, LARVAL GROWTH AND NUMBER OF VERTEBRAE OF THE GARFISH, BELONE BELONE,

Nederlands Instituut voor Onderzoek der Zee, Texel.

For primary bibliographic entry see Field 5C.

W77-04545

#### BRAIN GROWTH OF YOUNG HERRING AND TROUT,

Edinburgh Univ. (Scotland). Dept. of Physiology.

A. Packard, and A. W. Wainwright.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland May 17-23, 1973. p 499-507, 6 fig, 13 ref.

Descriptors: \*Animal physiology, Fish, \*Herring, \*Trout, Growth stages, Life history studies.

Identifiers: \*Brain development(Fish).

The paper reports changes in the total amount of DNA present in young herring and trout brains and in their wet weight. The herring brain was found to increase in absolute size from less than 50 micrograms at hatching to about 400 mg in large 3-year-olds. Individual points plotted on log/log paper reveal that brain growth is allometric. DNA was found to increase at a slower rate than brain wet weight. The trout results concerned a much narrower section of the growth range and show that except for the uptake of water and metabolic losses, the alevin hardly changes in weight from that of the fertilized egg. Evidence is presented that linear eye dimensions can be a direct indicator of brain growth, at least during the early part of the life history. (See also W77-04524) (Chilton-ORNL) W77-04546

#### EFFECTS OF REDUCED OXYGEN ON EMBRYOS AND LARVAE OF THE WHITE SUCKER, COHO SALMON, BROOK TROUT, AND WALLEYE,

Environmental Research Lab.-Duluth, Minn.

For primary bibliographic entry see Field 5C.

W77-04547

#### DEVELOPMENT OF THE RESPIRATORY SYSTEM IN HERRING AND PLAICE LARVAE, Dunstaffnage Marine Research Lab., Oban (Scotland).

C. de Silva.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 465-485, 5 tab, 11 fig, 28 ref.

Descriptors: Biology, \*Growth stages, \*Larvae, Fish, \*Herrings, Teleosts, Animal physiology, \*Respiration.

Identifiers: \*Plaice, Respiratory system, Gills.

The two species studied both hatch with gill arches but the arches are better developed in the plaice.

## Field 2—WATER CYCLE

### Group 21—Water In Plants

Gill filaments develop later in both species. The fins appear to play an important role in cutaneous respiration after hatching, but an inverse relationship is observed between fin area and gill area in the pre-metamorphic stages in both species. The role of the fins appears to become reduced as the gills develop. The slope of the gill area: body-weight relationship is greater before than after metamorphosis in both herring and plaice. Larval herring are found to have a higher gill area than plaice of the same weight which may be correlated to the greater activity of the herring. In the O group stage plaice show a more rapid increase in gill area and it is concluded that this higher rate of gill development may be of some adaptive value to young plaice migrating to the shallower parts of bay. (See also W77-04524) (Chilton-ORNL) W77-04548

**TEMPERATURE TOLERANCE OF EARLY DEVELOPMENT STAGES OF DOVER SOLE, SOLEA SOLEA (L.),**  
Ministry of Agriculture, Fisheries and Food, Port Erin (England). Fisheries Lab.  
For primary bibliographic entry see Field 5C.  
W77-04549

**EFFECTS OF CONSTANT AND RISING TEMPERATURES ON SURVIVAL AND DEVELOPMENT RATES OF EMBRYONIC AND LARVAL YELLOW PERCH, PERCA FLAVESCENS (MITCHILL),**  
Environmental Research Lab.-Duluth, Minn.  
For primary bibliographic entry see Field 5C.  
W77-04550

**EFFECT OF PARENTAL TEMPERATURE EXPERIENCE ON THERMAL TOLERANCE OF EGGS OF MENIDIA AUDENS,**  
Texas Univ., at Austin, Dept. of Zoology.  
For primary bibliographic entry see Field 5C.  
W77-04551

**EFFECT OF HYDROGEN SULFIDE ON DEVELOPMENT AND SURVIVAL OF EIGHT FRESHWATER FISH SPECIES,**  
Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.  
For primary bibliographic entry see Field 5C.  
W77-04552

**RESISTANCE OF PLAICE EGGS TO MECHANICAL STRESS AND LIGHT,**  
Deutsche Akademie der Wissenschaften zu Berlin (East Germany). Institut fuer Meereskunde.  
For primary bibliographic entry see Field 5C.  
W77-04553

**EFFECTS OF CADMIUM ON DEVELOPMENT AND SURVIVAL OF HERRING EGGS,**  
Biologische Anstalt Helgoland (West Germany).  
For primary bibliographic entry see Field 5C.  
W77-04554

**SURVIVAL OF AUSTRALIAN ANCHOVY (ENGRaulis australis) EGGS AND LARVAE IN A HEAT TRAP,**  
Trent Univ., Peterborough (Ontario).  
For primary bibliographic entry see Field 5C.  
W77-04555

**EFFECTS OF THERMAL SHOCK ON LARVAL ESTUARINE FISH-ECOLOGICAL IMPLICATIONS WITH RESPECT TO ENTRAINMENT IN POWER PLANT COOLING SYSTEMS,**  
National Marine Fisheries Service, Beaufort, N. C. Atlantic Estuarine Fisheries Center.  
For primary bibliographic entry see Field 5C.  
W77-04556

**A STUDY OF HABITAT WATER REGIME OF INUNDATED MEADOWS NEAR OSIJEK, (IN CROATIAN),**  
Agricultural Inst., Osijek (Yugoslavia). Food Science and Technology Inst.  
For primary bibliographic entry see Field 2G.  
W77-04582

### 2J. Erosion and Sedimentation

**SEDIMENT AND RUNOFF MEASUREMENTS FOR A TYPICAL GREAT PLAINS PRAIRIE LAKE,**  
South Dakota State Univ., Brookings. Dept. of Mechanical Engineering.  
For primary bibliographic entry see Field 5B.  
W77-04108

**AN EXPERIMENTAL INVESTIGATION OF THE RAINFALL ON THE TURBULENCE PROPERTIES OF OVERLAND FLOW,**  
Purdue Univ., Lafayette, Ind. School of Civil Engineering.  
For primary bibliographic entry see Field 2E.  
W77-04177

**BARATARIA BASIN: GEOLOGIC PROCESSES AND FRAMEWORK,**  
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.  
For primary bibliographic entry see Field 2L.  
W77-04187

**SHORELINE EROSION AND LANDSLIDES IN THE GREAT LAKES,**  
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.  
T. B. Edil, and L. E. Vallejo.  
Sea Grant Program Advisory Report No. 15, October 1976. 10 p, 8 fig, 1 tab, 6 ref.

Descriptors: \*Landslides, \*Lake Michigan, \*Great Lakes, \*Solifluction, \*Surface runoff, \*Slope stability, \*Bank erosion, \*Degradation(Slope), \*Lake shores, Erosion, Waves(Water).  
Identifiers: \*Wave action.

Stability of coastal bluffs is examined in order to determine the mechanics of bluff recession and the long-term trends in the evolution of coastal slopes. Six active bluffs in two locations on the western shore of Lake Michigan are monitored for erosion-sliding processes in an integrated program of field and laboratory investigation and stability analysis. Landslides constitute only one-part of the overall bluff toe and the degradation of the bluff face by solifluction and surface runoff. The effective stress analysis of slope stability provides a reliable method for predicting bluff recession in those bluffs where the rotational sliding is the main process of slope evolution. Two different models of slope evolution are established for the bluffs monitored. (NOAA)  
W77-04192

**TERRACES AND SHORELINES OF FLORIDA,**  
Geological Survey, Tallahassee, Fla. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04229

**EROSION OF SELECTED HAWAII SOILS BY SIMULATED RAINFALL,**  
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.  
E. W. Dangler, and S. A. El-Swaify.  
Soil Science Society of America Journal, Vol. 40, No. 5, p 769-773, September-October 1976. 2 fig, 6 tab, 12 ref. ARS-USDA 12-14-5001-19, 12-14-5001-40.

Descriptors: \*Erosion, \*Simulated rainfall, \*Soil types, \*Hawaii, Laboratory tests, Soils, Soil erosion, Erosion rates, Storms, Tropical regions, Runoff, Rainfall.  
Identifiers: \*Erodibility, \*Oahu(Hawaii), Tropical soils.

Erodibilities, or K values of the universal soil loss equation, were determined for ten soils, representing five soil orders, on the islands of Oahu and Hawaii. Two successive, simulated rainstorms were used, each with an approximate intensity of 6.35 cm/hour and duration of 2 hours. Values obtained covered the wide range from 0 to 0.60 metric tons/ha per metric erosion index x 0.00774 and, in most cases, were higher for the second (wet) than for the first (dry) storm. Erodibility values for cropped Oahu soils, belonging to four soil orders, ranged from 0 to 0.26 for dry storms and from 0.001 to 0.41 for wet storms. Values for volcanic ash soils on Hawaii, belonging to only two orders, had the considerably wider range of 0.08 to 0.60 for dry storms and 0.07 to 0.51 for wet storms. Three of these soils exhibited essentially the same erodibility for dry and wet conditions. Dry and wet values were combined to calculate a weighted mean erodibility for each soil based on the distributions of natural rainfall throughout the year at the test sites. The weighted erodibility of a soil at a given location was, in general, inversely related to the amount of natural precipitation at that location. (Sims-ISWS) W77-04251

### ESTIMATION OF THE PARAMETERS OF CATASTROPHIC MUDFLOWS IN THE BASINS OF THE LESSER AND GREATER ALMATINKA RIVERS,

B. S. Niayazov, and A. S. Degovets.  
Soviet Hydrology, Selected Papers, No. 2, p 75-80, November 1975. 4 fig, 3 tab, 15 ref. Translated from Gidrotekhnika i melioratsiya, No. 1, p 29-37, 1975.

Descriptors: \*Mudflows, \*Rivers, \*Glaciers, Landslides, Hazards, Damages, Foreign countries, Erosion, Sediments, Mud, Dams, Snowmelt, Excessive precipitation, Precipitation(Atmospheric), Streamflow.

Identifiers: \*\*USSR, \*Greater Almatinka River(USSR), \*Lesser Almatinka River(USSR), Catastrophes, Catastrophic mudflows.

The Lesser and Greater Almatinka rivers occupy one of the first places in the Soviet Union as far as mudflow activity and magnitude is concerned. Five large, catastrophic mudflows were observed in the USSR in the last 130 years (1841, 1921, 1950, 1956, and 1973). Three of the catastrophic mudflows were of rainfall origin, and two were of glacial origin (resulting from a breach of ice-dammed lakes). In all, 25 mudflows were recorded in this period in the Lesser Almatinka basin and 21 in the Greater Almatinka basin (80% due to heavy rains, 15% due to glacier outbursts, and 5% due to the breach of temporary bodies of water formed as a result of the damming of channels by snow avalanches or landslides during earthquakes). A brief description of catastrophic mudflows in the Lesser and Greater Almatinka basins was given. (Sims-ISWS) W77-04257

### SEDIMENT YIELD-RUNOFF-DRAINAGE AREA RELATIONSHIPS IN THE UNITED STATES,

Agricultural Research Service, Oxford, Miss. Sedimentation Lab.  
F. E. Dendy, and G. C. Bolton.  
Journal of Soil and Water Conservation, Vol. 31, No. 6, p 264-266, November-December 1976. 5 fig, 1 tab, 11 ref.

Descriptors: \*Sediment yield, \*Watersheds(Basins), \*Drainage area, Reservoirs, Mathematical studies, Analytical techniques, Statistical methods, Regression analysis, Equa-

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## WATER CYCLE—Field 2

### Estuaries—Group 2L

tions, Runoff, Annual, Large watersheds, Small watersheds.

Watershed sediment yields, as determined from sediment deposits in about 800 reservoirs, were related to drainage area size and mean annual runoff. Average sediment yields per unit of net drainage area were inversely proportional to the 0.16 power of drainage area. Average sediment yields increased sharply to about 1,860 tons per square mile of drainage area as runoff increased from 0 to about 2 inches, and then decreased as runoff increased from 2 to about 50 inches. (Humphreys-ISWS) W77-04272

#### EROSION CONTROL.

Soil Conservation Service of New South Wales, Coban (Australia).

For primary bibliographic entry see Field 4D.

W77-04315

**THE EFFECT OF CULTIVATION ON THE WIND-BORNE SAND SEDIMENTS IN EGYPT,**  
Cairo Univ., Giza (Egypt). Faculty of Agriculture; and Cairo Univ., Giza (Egypt). Dept. of Soils. For primary bibliographic entry see Field 2G.

W77-04316

**HEAVY METAL ACCUMULATION IN ESTUARINE SEDIMENTS IN A HISTORICAL MINING OF CORNWALL,**  
Hong Kong Univ. Dept. of Geography and Geology. For primary bibliographic entry see Field 5B.

W77-04329

**A SENSIBLE ALTERNATIVE TO STREAM CHANNELIZATION,**  
North Carolina Univ. at Charlotte. Dept. of Geography and Earth Science. For primary bibliographic entry see Field 4A.

W77-04388

**SEDIMENT PRODUCTION AND INFILTRATION RATES AS AFFECTED BY GRAZING AND DEBRIS BURNING ON CHAINED AND SEDED PINYON-JUNIPER,**  
Utah State Univ., Logan. Dept. of Range Service. For primary bibliographic entry see Field 4C.

W77-04393

**SHORELINE WAVES, ANOTHER ENERGY CRISIS,**  
Virginia Inst. of Marine Science, Gloucester Point. For primary bibliographic entry see Field 2L.

W77-04467

**BEACH FILL PLANNING - BRUNSWICK COUNTY, NORTH CAROLINA,**  
Army Engineer District, Wilmington, Del. Coastal Engineering Studies Section. For primary bibliographic entry see Field 2L.

W77-04471

**ADVANCING TO THE REAR: A STRATEGY OF COASTAL ZONE MANAGEMENT ON ERODING SHORELINES (PRELIMINARY DISCUSSION),**  
For primary bibliographic entry see Field 2L.

W77-04488

**A SYSTEMS ANALYSIS MODEL FOR CALCULATING RADIONUCLIDE TRANSPORT BETWEEN RECEIVING WATERS AND BOTTOM SEDIMENTS,**  
Oak Ridge National Lab., Tenn. Environmental Sciences Div. For primary bibliographic entry see Field 5B.

W77-04516

## 2K. Chemical Processes

**'ANALYSIS, CHARACTERIZATION, AND EFFECTS OF HEAVY METAL CHELATING AGENTS IN WATER',**  
Missouri Univ.-Columbia. Dept. of Chemistry. For primary bibliographic entry see Field 5A.

W77-04141

**WATEQF-A FORTRAN IV VERSION OF WATEQ, A COMPUTER PROGRAM FOR CALCULATING CHEMICAL EQUILIBRIUM OF NATURAL WATERS,**  
Geological Survey, Reston, Va. Water Resources Div. For primary bibliographic entry see Field 7C.

W77-04226

**WATER RESOURCES OF NORTHWESTERN WYOMING,**  
Geological Survey, Cheyenne, Wyo. Water Resources Div. For primary bibliographic entry see Field 2A.

W77-04238

**GEOLOGY AND GROUND-WATER RESOURCES OF NORTHERN MERCER COUNTY, PENNSYLVANIA,**  
Geological Survey, Harrisburg, Pa. Water Resources Div. For primary bibliographic entry see Field 2F.

W77-04239

**NATURAL WATER AND CHEMICAL BUDGETS FOR A SMALL PRECAMBRIAN LAKE BASIN IN CENTRAL CANADA,**  
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.

D. W. Schindler, R. W. Newbury, K. G. Beaty, and P. Campbell. Journal of the Fisheries Research Board of Canada, Vol. 33, No. 11, p 2526-2543, November 1976. 4 fig, 10 tab, 77 ref.

Descriptors: \*Water quality, \*Small watersheds, \*Lakes, \*Canada, \*Hydrologic budget, Watersheds(Basins), Hydrology, On-site investigations, Sampling, Surveys, Streams, Data collections, Chemicals, Nutrients, Groundwater. Identifiers: \*Rawson Lake watershed(Manitoba), \*Manitoba, Chemical budget.

Results of a 4-yr study of the hydrology of the Rawson Lake watershed, as well as the chemistry of precipitation, streamflow, and the lake, were presented. Inputs of water and most chemicals varied by as much as 2 times from one year to the next, illustrating that several years' data are necessary to determine accurately average nutrient inputs and losses from an ecosystem. Precipitation appeared to be almost the sole source of P and N to lake and terrestrial ecosystems, although N<sub>2</sub> fixation cannot be dismissed in the latter case. Significant proportions of Ca, Mg, Na, K, Cl, and SO<sub>4</sub> were supplied directly from precipitation. The lake also received substantial quantities of these elements, as well as silicon, from weathering of terrestrial geological materials. Although far from any major industrial sources of SO<sub>2</sub>, the pH of precipitation averaged less than 5 for the years studied. Both terrestrial and lake systems retained a high proportion of entering P and N, and smaller proportions of other nutrients. Interpretation of relative retentions of nutrients revealed that the terrestrial ecosystem has well-balanced P and N supplies, while the lake was P limited. Rates of loss of chemicals from the terrestrial watershed of Rawson Lake are comparable to other sites in the Precambrian Shield, but lower than values from other geological settings. (Humphreys-ISWS) W77-04275

**DETERMINATION OF NANOMOLE QUANTITIES OF CARBONYL COMPOUNDS USING TWIN CELL POTENTIAL SWEEP VOLTAMMETRY,**  
Canada Centre for Inland Waters, Burlington (Ontario).

For primary bibliographic entry see Field 5A.

W77-04573

## 2L. Estuaries

**ESTUARINE POLLUTION, A BIBLIOGRAPHY, VOLUME 2,**  
Office of Water Research and Technology, Washington, D.C. For primary bibliographic entry see Field 5B.

W77-04109

**ESTUARINE POLLUTION, A BIBLIOGRAPHY, VOLUME 3,**  
Office of Water Research and Technology, Washington, D.C. For primary bibliographic entry see Field 5B.

W77-04110

**POTENTIAL REPLACEMENT OF SEPTIC TANK DRAIN FIELD BY ARTIFICIAL MARSH WASTE WATER TREATMENT SYSTEMS,**  
Wisconsin Univ.-Oshkosh. Dept. of Geology. For primary bibliographic entry see Field 5D.

W77-04117

**GROWTH REQUIREMENTS OF ENTEROMORPHA COMPRESSA AND CODIUM FRAGILE,**  
Environmental Research Lab., Narragansett, R.I. For primary bibliographic entry see Field 5C.

W77-04162

**HEAVY METAL LEVELS IN SUSPENDED PARTICULATES, BIOTA, AND SEDIMENTS OF THE ST. CROIX ESTUARY IN MAINE,**  
Maine Univ., Walpole. Dept. of Oceanography. For primary bibliographic entry see Field 5B.

W77-04176

**STATE OF OREGON COASTAL ZONE MANAGEMENT PROGRAM, DRAFT ENVIRONMENTAL IMPACT STATEMENT,**  
National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management. For primary bibliographic entry see Field 6G.

W77-04184

**PROPOSED FEDERAL APPROVAL OF THE COASTAL ZONE MANAGEMENT PROGRAM, MID-COAST SEGMENT, STATE OF MAINE, DRAFT ENVIRONMENTAL IMPACT STATEMENT,**  
National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management.

For primary bibliographic entry see Field 6G.

W77-04185

**BARATARIA BASIN: GEOLOGIC PROCESSES AND FRAMEWORK,**  
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.

R. D. Adams, B. B. Barrett, J. H. Blackmon, B. W. Gane, and W. G. McIntire. Sea Grant Publication No. LSU-T-76-008, June 1976. 111 p, 22 fig, 9 tab, 76 ref.

Descriptors: \*Louisiana, \*Geomorphology, \*Wetlands, \*Coastal marshes, \*Sedimentation, \*Aquatic plants, \*Resources development, Vegetation, Beach erosion, Salt marshes, Tidal effects, Salt water intrusion, Tidal marshes.

## Field 2—WATER CYCLE

### Group 2L—Estuaries

Identifiers: Water movement, Spartina alterniflora, Coastal processes, Environmental conditions, \*Barataria Basin(LA), Coastal zone management.

The landforms and processes that are operative in Louisiana's coastal wetland are described. Processes that cause marsh deterioration and land loss are also discussed. To obtain information on land loss the environmental units were inventoried and assessed to determine the status of existing resources for environmental units, parishes, and basin. Study of dredge and fill activities and their intensities for each environmental unit and parish were established. Coastal erosion and inlet changes were quantified. Sea-level changes, subsidence, storms, and salinity intrusion were studied as a combination of natural destructive processes, balanced by sediment production in the marshes and swamps and storm-deposited inorganic sediments deposited over marshlands. Coastal erosion effects, marsh deterioration by water movement, and vegetation response to salinity intrusion and tidal pulses that remove organic detritus and cause erosion of the marsh surface are also considered. (See also W77-04188) (NOAA)  
W77-04187

**BARATARIA BASIN: BIOLOGICAL CHARACTERIZATION,**  
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.

L. M. Bahr, and J. J. Hebrard.  
Sea Grant Publication No. LSU-T-76-005, May 1976. 154 p, 3 fig, 43 tab, 66 ref, append.

Descriptors: \*Ecosystems, \*Louisiana, \*Baseline studies, \*Aquatic life, \*Wetlands, \*Water pollution sources, \*Aquatic habitats, Ecology, Environmental effects, Estuaries, Marshes, Beaches, Physical processes, Chemical processes, Coastal marshes, Salt marshes, Bayous, Swamps.  
Identifiers: \*Nutrient transport, \*Barataria Basin(LA), Coastal zone management.

The biological characterization of the Barataria Basin includes a functional description of biological processes at both the ecosystem (basin) level and the habitat level, as well as summaries of research on distribution and abundance of animal groups. Water represents the prime integrating feature of the total ecosystem. The importance of rainfall, tidal flow, wind, temperature, storms, meandering of streams, and discharge from the Mississippi River is emphasized in relation to distributions of organisms and nutrients and also as a vehicle for pollutants. On the habitat level, swamp forests, fresh marshes, brackish marshes (including the intermediate marsh), saline marshes, beaches, and other elevated areas (i.e., chenieres, natural levees, and spoil banks) are discussed in terms of probable energy pathways by classification of organisms as producers, primary consumers (herbivores and detritivores), or secondary consumers (carnivores), with emphasis on water and its relationship to nutrient transport. (See also W77-04187) (NOAA)  
W77-04188

**APPLICATION OF ESTIMATION THEORY TO DESIGN OF SAMPLING PROGRAMS FOR VERIFICATION OF COASTAL DISPERSION PREDICTION,**  
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5B.  
W77-04191

**THE EXTENT TO WHICH MARINE TRANSPORTATION WITHIN THE ECONOMIC ZONE WILL BE AFFECTED BY ENFORCEMENT OF THE PROPOSED POLLUTION CONTROLS,**  
Woods Hole Oceanographic Institution, Mass. Dept. of Applied Oceanography.  
For primary bibliographic entry see Field 5G.

W77-04194

**ATMOSPHERIC TRACE METALS OVER THE NEW YORK BIGHT,**  
National Oceanic and Atmospheric Administration, Boulder, Colo. Marine Ecosystems Analysis Program Office.

For primary bibliographic entry see Field 5B.  
W77-04195

**SYMPORIUM, THE FUTURE OF CHESAPEAKE BAY.**

For primary bibliographic entry see Field 6G.  
W77-04203

**FIRST DATA ON THE PRESENCE OF SOME METALLIC ELEMENTS IN MYTILUS GALLOPROVINCIALIS, LAM. OF THE EASTERN SICILIAN COAST, REVEALED BY ATOMIC ABSORPTION SPECTROPHOTOMETRY, (IN ITALIAN),**  
Catania Univ. (Italy).

For primary bibliographic entry see Field 5A.  
W77-04207

**APPLICATION OF A THREE-DIMENSIONAL MODEL TO COMPUTATIONS OF STORM SURGES IN THE BLACK SEA,**

For primary bibliographic entry see Field 2B.  
W77-04260

**SYMMETRIC FINITE-AMPLITUDE ROTATIONAL WATER WAVES,**  
Delaware Univ., Newark. Dept. of Civil Engineering.

R. A. Dalrymple, and J. C. Cox.  
Journal of Physical Oceanography, Vol. 6, No. 6, p 847-852, November 1976. 4 fig, 1 tab, 22 ref.

Descriptors: \*Waves(Water), \*Mathematical studies, \*Mathematical models, \*Oceanography, Theoretical analysis, Analytical techniques, Ocean waves, Wavelengths, Fluctuations, Equations, Analysis, Potential flow, Shallow water, Deep water.

Two forms of a two-dimensional streamfunction solution for symmetric periodic water waves on a fluid with a vertical distribution of vorticity were presented. The magnitude of the vorticity varies linearly with the magnitude of the streamfunction, while remaining constant on a particular streamline. The analysis utilized a numerical perturbation technique, which converges rapidly to a wave of given height and period in water of a specified depth with a given vorticity distribution. Computed results showed the influence of the vorticity on the wavelength and crest elevation of the wave. The effects of the mean current are to change all the properties of the waves, except wave height and period which are fixed. Aiding currents were shown to increase the horizontal velocities under the wave crest and to increase wavelength and the crest elevation, while an opposing current has the opposite effect. The importance of these changes occurs in the design of offshore structures, where small percentage changes in horizontal velocities result in twice as large changes in drag forces on structures. Further, the deck elevation of structures is dependent on knowledge of crest elevation. (Humphreys-ISWS)  
W77-04266

**COASTAL-TRAPPED WAVES IN A CONTINUOUSLY STRATIFIED OCEAN,**  
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.

D.-P. Wang, and C. N. K. Mooers.  
Journal of Physical Oceanography, Vol. 6, No. 6, p 853-863, November 1976. 11 fig, 2 tab, 15 ref. NSF DES 7408463.  
W77-04271

Descriptors: \*Internal waves, \*Ocean waves, \*Theoretical analysis, \*Coasts, Mathematical studies, Equations, Interfaces, Analysis, Waves(Water), Oceans, Oceanography, Density stratification, Mathematical models.

Identifiers: Kelvin waves, Rossby waves.

The theory of coastal-trapped waves was extended to include the general features of continuous density stratification, variable bottom topography, and a finite coastal wall. In the limit of a vanishing coastal wall, topographic Rossby waves are the only class of sub-inertial frequency, trapped wave motion. The stratification effect on topographic Rossby waves depends on both the local baroclinic radius of deformation and the characteristic offshore length scale of the wave motion. For intermediate density stratification, long waves are nearly depth-independent in the shelf region, and they are bottom-trapped in the slope region. The topographic Rossby waves reduce to the barotropic shelf waves and the bottom-trapped waves in the limits of small and large density stratification, respectively. In the general case of comparable influences from the coastal wall and bottom slope effects, baroclinic Kelvin waves and topographic Rossby waves are eigenmodes of the system. The eigenfunctions were modified from the elementary cases, which can be discerned by their structures along the coastal and bottom boundaries. In particular, a resonance condition was suggested, i.e., the properties of a wavemode vary with the wavenumber and stratification. For example, mode 1 is a topographic Rossby wave for small wavenumbers, and it is a baroclinic Kelvin wave for large wavenumbers. Also, the high-frequency cutoff found in the barotropic theories is lost. (Humphreys-ISWS)  
W77-04267

**EUSTATIC SEA VARIATION IN THE LAST 2000 YEARS IN THE MEDITERRANEAN,**  
Bologna Univ. (Italy). Instituto di Fisica.

M. Caputo, and L. Pieri.  
Journal of Geophysical Research, Vol. 81, No. 33, p 5787-5790, November 20, 1976. 4 fig, 1 tab, 2 ref.

Descriptors: \*Sea level, \*Archaeology, \*History, Harbors, Docks, Shores, Aerial photography, Coastal structures, Foreign countries, Mathematical studies.

Identifiers: \*Sea variation, \*Mediterranean Sea, \*Italy, Archeological ruins, Fish ponds, Harbor wharves, Tide gages, Ancient shorelines.

The rise in the sea level of the Mediterranean Sea in the period ranging from 600 B.C. to 100 A.D. was studied by using archeological ruins chosen in order to give assurance with respect to the date and the height. Among the archeological structures visible and in contact with the sea at that time, Roman fish ponds, harbor wharves, and docks were the most important. A plot of measured depth versus date showed that from 600 B.C. to 100 A.D. the Mediterranean Sea rose from -1.7 to -0.4 m with respect to mean sea level in 1884. Two least squares regression lines with 95% confidence region were drawn. The first, which included all 22 data sets, showed a rise of the mean sea level of 1.7 mm/year in the time span from 600 B.C. to 100 A.D.; one, containing only 20 data sets, showed a rise of the mean sea level of 1.4 mm/year in the same time period. This rise of the sea may have ended around the year 350 A.D. A rise of 1.4 mm/year agreed with the rise of the Mediterranean Sea as recorded in the last century by tide gage. The altimetric data for buried ruins were obtained by means of traditional geometric leveling; for underwater ruins, in situ measurements were taken with reference to the present sea level, while the values with respect to the mean sea level were calculated on site by means of harmonic forecast of tidal movements. (Roberts-ISWS)  
W77-04271

## WATER CYCLE—Field 2

### Estuaries—Group 2L

**BIOMASS AND REMOTE SENSING OF AQUATIC MACROPHYTES IN THE PAMlico RIVER ESTUARY,**  
East Carolina Univ., Greenville. Dept. of Biology.  
For primary bibliographic entry see Field 5C.  
W77-04325

**PRIMARY PRODUCTIVITY AND BIOMASS DISTRIBUTION OF AQUATIC MACROPHYTES IN THE LOWER CHOWAN RIVER,**  
East Carolina Univ., Greenville, N. C. Dept. of Biology.  
For primary bibliographic entry see Field 5C.  
W77-04326

**DEEP-SEA BACTERIA: GROWTH AND UTILIZATION OF N-HEXADECANE AT IN SITU TEMPERATURE AND PRESSURE,**  
Maryland Univ., College Park. Dept. of Microbiology.  
For primary bibliographic entry see Field 5C.  
W77-04328

**HEAVY METAL ACCUMULATION IN ESTUARINE SEDIMENTS IN A HISTORICAL MINING OF CORNWALL,**  
Hong Kong Univ. Dept. of Geography and Geology.  
For primary bibliographic entry see Field 5B.  
W77-04329

**BASELINE STUDIES OF DELAWARE OCEAN OUTFALL SITES,**  
Delaware Univ., Lewes. Coll. of Marine Studies.  
For primary bibliographic entry see Field 5A.  
W77-04330

**UPTAKE AND RELEASE OF PHOSPHOROUS BY PHYTOPLANKTON IN THE CHESAPEAKE BAY ESTUARY, USA,**  
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.  
For primary bibliographic entry see Field 5C.  
W77-04332

**DISTRIBUTION AND ABUNDANCE OF ICHTHYOPLANKTON IN THE NEW YORK BIGHT DURING THE FALL IN 1971,**  
New York Ocean Science Lab., Montauk.  
For primary bibliographic entry see Field 5B.  
W77-04333

**BACTERIAL ATTACK OF CORALS IN POLLUTED SEAWATER,**  
Harvard Univ., Cambridge, Mass. Lab. of Applied Microbiology.  
For primary bibliographic entry see Field 5C.  
W77-04335

**FECUNDITY OF COHO SALMON (ONCORHYNCHUS KISUTCH) FROM THE GREAT LAKES AND A COMPARISON WITH OCEAN SALMON,**  
Michigan Dept. of Natural Resources, Marquette.  
For primary bibliographic entry see Field 2H.  
W77-04344

**BURROWING ACTIVITY IN MERCENARIA MERCENARIA (L.) AND SPISULA SOLIDISSIMA (DILLWYN) AS A FUNCTION OF TEMPERATURE AND DISSOLVED OXYGEN,**  
Rhode Island Univ., Kingston. Graduate School of Oceanography.  
For primary bibliographic entry see Field 5C.  
W77-04345

**WATERGATE VILLAGE: A CASE STUDY OF A PERMIT APPLICATION,**  
Maryland Univ., Baltimore. School of Law.

For primary bibliographic entry see Field 6E.  
W77-04349

**LOUISIANA TIDELANDS PAST AND FUTURE,**  
Louisiana Office of the Attorney General, Baton Rouge.  
For primary bibliographic entry see Field 6E.  
W77-04350

**THE COAST: WHERE ENERGY MEETS THE ENVIRONMENT,**  
San Diego Univ., Calif. School of Law.  
For primary bibliographic entry see Field 6E.  
W77-04351

**THE CASE OF THE INCIDENTAL LOBSTER: UNITED STATES REGULATION OF FOREIGN HARVESTING OF CONTINENTAL SHELF FISHERY RESOURCES,**  
Le Boeuf, Lamb, Leiby and MacRae, Washington, D. C.  
For primary bibliographic entry see Field 6E.  
W77-04352

**PROTECTION AND CONTROL OF THE SALT WATER SHORE AREA,**  
Rhode Island Statewide Planning Program, Providence.  
For primary bibliographic entry see Field 6E.  
W77-04361

**THE COASTAL INTERFACE: WHO OWNS WHAT,**  
Florida Univ., Gainesville. School of Law.  
For primary bibliographic entry see Field 6E.  
W77-04362

**GAS BUBBLE DISEASE MORTALITY OF ATLANTIC MENHADEN, BREVOORTIA TYRANNUS, AT A COASTAL NUCLEAR POWER PLANT,**  
Boston Edison Co., Mass. Nuclear Engineering Dept.  
For primary bibliographic entry see Field 5C.  
W77-04424

**OBSERVATIONS ON THE EFFECTS OF GAS EMBOLISM IN CAPTURED ADULT MENHADEN,**  
New England Aquarium, Boston, Mass.  
For primary bibliographic entry see Field 5C.  
W77-04425

**THE PRESENT AND FUTURE OF COASTS.**  
Coastal Society, Bethesda, Md.  
Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA on November 1975. 287 p.

Descriptors: \*Coasts, \*Resources development, \*Baseline studies, \*Leases, \*Environmental effects, Oil industry, \*Legal aspects, Water resources, \*Water pollution sources, Estuaries, Shore protection, Beach erosion, Social values, Planning, Management, Aesthetics, Land use, Oil pollution, \*Conferences.  
Identifiers: \*Outer Continental Shelf, \*Coastal zone management, \*Energy resources, Energy sources.

A collection of 27 papers constitutes the proceedings of the First Annual Conference of the Coastal Society held in Arlington, Virginia, November 1975. The uses of the coastal zone was offered for wide-ranging discussion of these issues. Offshore oil development, as a special problem, was presented by representatives of Congress, Government, the oil industry, and ecological conservation. Other aspects of energy as well as food resources of the coastal region

were explored. And, finally, attempts were made to look at some of the problems of environmental-impact assessment and the efforts to obtain and maintain environmental quality along our shores. The Conference looked at planning, resource development, environmental impact, and the ways in which man and the coastal zone interact. In all these areas it was clear that there is an urgent need for better means of communication, particularly with the people, who in the end must pay the bill, whether it be in money, resources that are diminished or lost, natural beauty that is marred, or an opportunity that is not grasped. (See W77-04463 thru W77-04489) (Sinha-OEIS)  
W77-04462

**WHERE CALIFORNIA STANDS ON PLANNING FOR ITS COAST,**  
California Coastal Zone Conservation Commission, San Francisco.

E. J. Schoop.  
In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA on November 1975. p 5-10.

Descriptors: \*Coasts, \*California, \*Planning, Conservation, Management, Resources development, Land use, Water resources, Quality control.  
Identifiers: \*Coastal zone management.

Popular concern in California led first to saving San Francisco Bay from further filling, then to creation of a powerful interim Coastal Commission to plan the future of the Coast. The essence of the Coastal Plan is that the coast should be treated not as ordinary real estate but as a unique place, where conservation and special kinds of development should have priority. The Plan actively promotes: productive agriculture, viable communities and neighborhoods, expansion of commercial fishing activity and fisheries research, acquisition of additional parklands, restoration of degraded coastal environments, and continued development of existing ports and marinas. The Plan seeks to achieve balance where there is a competition among goals, such as where increasing coastal access competes with resource protection, where economic development conflicts with conservation, where urban expansion competes with the retention of natural areas, or where short-run gains result in the forfeiture of long-run economic benefits. (See also W77-04462) (Sinha-OEIS)  
W77-04463

**COASTAL-ZONE PLANNING: AN INTEGRATED APPROACH,**  
Nassau-Suffolk Regional Planning Board, N.Y.  
L. E. Koppelman.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA on November 1975. p 11-24, 2 tab, 16 ref.

Descriptors: \*New York, \*Coasts, Planning, Water supply, Resources development, Environment, Conservation.  
Identifiers: \*Coastal zone management.

Two major factors in coastal zone planning are the use of natural science inputs as determinants of the environmental loadings resulting from any class of land uses, and the translation of technical and planning results and recommendations in language and form clearly understandable by the general public and elected officials. The experience gained in force field on Long Island serves as a case study. (See also W77-04462) (Sinha-OEIS)  
W77-04464

**THE NORTH CAROLINA COASTAL AREA MANAGEMENT ACT — A PROGRAM OF**

## Field 2—WATER CYCLE

### Group 2L—Estuaries

**STATE-LOCAL GOVERNMENT COOPERATIVE PLANNING IN THE COASTAL ZONE,**  
North Carolina Dept. of Natural and Economic Resources, Raleigh.

A. W. Cooper.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA on November 1975. p 29-36.

Descriptors: \*North Carolina, \*Planning, \*Coasts, Resources development, \*Management, Water resources, \*State governments.

Identifiers: \*Coastal zone management, Private property rights, Environmental protection.

North Carolina is one of the few States in the nation to have enacted and begun implementation of comprehensive coastal zone management legislation. The Act mandates a joint state-local program of planning and management for the coastal zone. One of the principal features of the program is its provision for a mandatory program of land use planning by local governments. The act authorizes designation of critical environmental areas, what the act refers to as areas of environmental concern. A program of permits for developments in areas of environmental concern is also established. The act contains in several places pointed statements relating to the taking of private property rights by government and assurances for the protection of private property rights. The basic concept of the act is to develop a truly cooperative planning process, involving State and local government, each with fairly specific, well-prescribed roles. In summary, North Carolina Coastal Area Management Act provides what is considered a strong basis for development of a State program. It mandates a planning effort and the framework for regulation. In order to achieve maximum success under the act, full coordination of existing state programs and integrations of these with the state act must be developed. (See also W77-04462) (Sinha-OEIS)

W77-04465

**COASTAL ZONE LEGISLATION: LOUISIANA LANDMARKS, LABYRINTHS AND LOGROLLING,**

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.

J. R. Van Lopik.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA on November 1975. p 37-48, 5 ref.

Descriptors: \*Coasts, \*Louisiana, \*Legislation, Ecosystems, \*Planning, \*Management, Resources development.

Identifiers: \*Coastal zone management, Educational needs.

The evolution of coastal zone management in Louisiana has indicated needs for better understanding of coastal ecosystem function, increased cooperation between state agencies and universities to permit more effective use of existing knowledge, and evaluation of proposed legislation in terms of complexity, cost, continuity, content, competence, control and coordination. Attitudinal changes can be effected by conduct of carefully staffed, working-level cooperative programs—coupled with the elimination of red tape presently connected with institutional arrangement, contractual procedures, and state civil service regulations which work against the development of truly cooperative team efforts. The knowledge base must be improved. Most problems regarding the coastal zone stem from the fact that man wants to live, work and play there. He conducts these activities—and probably will continue to do so—despite the frequently inhospitable nature of the zone and for a variety of economic, psychologic and unknown reasons. (See also W77-04462) (Sinha-OEIS)

W77-04466

**SHORELINE WAVES, ANOTHER ENERGY CRISIS,**  
Virginia Inst. of Marine Science, Gloucester Point. V. Goldsmith.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p 49-57, 3 fig, 1 tab, 4 ref. Also as Virginia Inst. Marine Science Contrib. No. 734.

Descriptors: \*Virginia, \*Beach erosion, \*Waves(Water), \*Shore protection, \*Erosion control, Sedimentation, Bathymetry.

Identifiers: \*Wave energy, \*Wave refraction, Coastal zone management.

The analytical modeling of wave refraction, the primary mechanism controlling the distribution of wave heights along a beach, are discussed. Case histories of shoreline response from the modification of the sea floor bathymetry both by natural processes and by man are discussed. It is suggested that such bathymetric modifications be initiated as a means of 'controlling' the observed non-uniform shoreline wave energy distribution, and thus assuring that everyone gets their fair share of wave energy, and no more. (See also W77-04462) (Sinha-OEIS)

W77-04467

**EXPLORATION AND PETROLEUM DEVELOPMENT OF THE U.S. OUTER CONTINENTAL SHELF: A MOVE TOWARD SELF-SUFFICIENCY,**

For primary bibliographic entry see Field 6G.

W77-04468

**FLORIDA'S EXPERIENCE - THE WAY WE WERE - AND SHOULDN'T HAVE BEEN,**  
Florida Audubon Society, Maitland.

For primary bibliographic entry see Field 5G.

W77-04469

**ECOLIBRIUM, A BALANCE BETWEEN ECONOMY AND ECOLOGY,**

National Oceanic and Atmospheric Administration, Washington, D.C. Office of the Administrator.

For primary bibliographic entry see Field 6G.

W77-04470

**BEACH FILL PLANNING - BRUNSWICK COUNTY, NORTH CAROLINA,**  
Army Engineer District, Wilmington, Del. Coastal Engineering Studies Section.

L. Vallianos.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p 93-114, 4 fig, 2 tab, 4 ref, 1 plate.

Descriptors: \*North Carolina, \*Shore protection, \*Resources development, Planning, Beaches.

Identifiers: Beach nourishment, Environmental impact, Engineering design, Coastal zone management.

Planning has recently been completed for a shore protection project along a 9-mile reach of shoreline fronting the Towns of Yaupon Beach and Long Beach in Brunswick County, North Carolina. The investigative program related to this planning effort embodied numerous interrelated elements which, on integration, resulted in a rational engineering design having a continuous beach fill as the central feature. Specifically, the investigation included: (1) definition of the environment, vis, wind, waves, storm tide frequencies, beach profile characteristics, shore processes, and ecological habitats along the proposed project area as well as in potential beach fill sources; (2) Designs and cost estimates including establishment of various fill profile configurations, cost optimization of fill positions, evaluation

of the frequency of shoreline retreat and the attendant displacement of fill materials, evaluation of the compatibility of materials from various fill sources with the natural beach materials, environmental impact studies, and economic studies; and (3) Final plan formulation arriving at the optimum fill plan in terms of engineering functionality, economics, and minimal adverse environmental impact (see also W77-04462) (Sinha-OEIS)

W77-04471

**COASTAL ENVIRONMENTAL IMPACT ASSESSMENT: LESSONS FROM OIL SPILLS,**  
University of Southern California, Los Angeles. Allan Hancock Foundation.

For primary bibliographic entry see Field 6G.

W77-04472

**FARMERS AND FISHERMEN: INTERACTION IN THE COASTAL ZONE,**  
Maryland Univ., College Park. Cooperative Extension Service.

For primary bibliographic entry see Field 6G.

W77-04473

**PEOPLE AND THE SEA: FUTURE IMPACTS AND OPPORTUNITIES,**

Delaware Univ., Lewes. Coll. of Marine Studies; and Delaware Univ., Newark. Marine Studies Complex.

For primary bibliographic entry see Field 6G.

W77-04474

**THE USE OF REMOTE SENSING FOR COASTAL ZONE MONITORING,**

Texas A and M Univ., College Station. Remote Sensing Center.

For primary bibliographic entry see Field 5B.

W77-04475

**THERMAL POLLUTION IN THE LOS ANGELES-LONG BEACH HARBOR: CONSEQUENCES AND ALTERNATIVES,**  
University of Southern California, Los Angeles. Allan Hancock Foundation.

For primary bibliographic entry see Field 5B.

W77-04476

**THE WETLANDS DILEMMA: A SOLUTION,**  
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.

For primary bibliographic entry see Field 6G.

W77-04477

**IN INTENSIVE BIOMETRIC INTERTIDAL SURVEY (PROJECT IBIS). A SALT MARSH MONITORING STUDY,**

American Univ., Washington, D.C. Marine Science Program.

R. W. Crist, and T. G. Reidenbaugh.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 182-187, 14 ref.

Descriptors: \*Marsh management, \*Monitoring, \*Baseline studies, \*Virginia, \*Intertidal areas, Coasts, \*Ecosystems, Ecological distribution, \*Salt marshes, \*Surveys.

Identifiers: Coastal zone management, Biometric surveys, Intensive Biometric Intertidal Survey(IBIS), \*Wallop Island(VA).

Studies are currently being conducted in a salt marsh on Wallop Island, Virginia, by Project IBIS. The design of the project is centered around observing development of the marsh system through long-term investigations of biological, chemical, and physical parameters. The goal of IBIS is to establish an extensive data base through long-term monitoring of a salt marsh study site.

Recognition of trends important to the natural development of the ecosystem will result. The implications in management are discussed. (See also W77-04462) (Sinha-OEIS)  
W77-04478

**THE ROLE OF PUBLIC PARTICIPATION IN COASTAL ZONE MANAGEMENT: AN ASSESSMENT OF THE ATTITUDES OF RELEVANT INTEREST GROUP LEADERS TOWARDS CZM '72.**

Texas A and M Univ., College Station. Dept. of Political Science.

For primary bibliographic entry see Field 6B.

W77-04479

**COASTAL LANDFORMS AND SCENIC ANALYSIS: A REVIEW,**

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

For primary bibliographic entry see Field 6B.

W77-04480

**FOCUSING ON VISUAL QUALITY OF THE COASTAL ZONE,**

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

For primary bibliographic entry see Field 6B.

W77-04481

**THE ANNUAL CYCLE OF WAVE CLIMATES ALONG THE EAST COAST OF THE UNITED STATES,**

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.

B. P. Hayden.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 225-231, 1 fig, 1 tab, 10 ref.

Descriptors: \*Waves(Water), \*Estuaries, \*Beaches, Coasts, Shore protection.

Identifiers: Wave climate, Coastal zone management, Seasonal variations, Atmospheric circulation, \*Eastern U.S. coasts.

The annual component of the seasonal variation in wave climates along the United States Atlantic coast is documented. Throughout the mid-Atlantic region, the summer wave-climate regime begins in mid-April and ends during the first week in September. In the Gulf of Maine summer begins in early May and ends in mid-October. Along the Florida coast the summer regime is initiated in late May and ends during the first week of September. The coincidence of the timing of these wave-climate seasons with changes in the general circulation of the atmosphere is discussed. (Sinha-OEIS)  
W77-04482

**THE UTILIZATION OF THE APT AND ATS SATELLITE COMMUNICATION SYSTEMS IN COASTAL RESEARCH PROGRAMS,**

Texas A and M University, College Station. Remote Sensing Center.

J. M. Hill, P. Babai, and C. Vermillion.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 232-240, 2 fig, 11 ref.

Descriptors: \*Remote sensing, \*Satellites(Artificial), \*Operations research, Communication, Monitoring, Data transmission.

Identifiers: Coastal processes, Automatic Technology Satellite, \*Automatic Picture Transmission.

Research programs involving the shipboard study of coastal processes have been limited in the past

by several obstacles. Ship time is very expensive and a means to quickly locate the specific areas of interest has been needed. Most studies of this sort have been conducted by the use of historical data as a tool to locate these areas. Another obstacle has been in the relaying of pertinent scientific data both to and from research vessels while in operation at sea. The Automatic Technology Satellite (ATS) and the Automatic Picture Transmission (APT) communication systems have proven to be valuable tools in alleviating these and several other related problems encountered during operational coastal research programs. (See also W77-04462) (Sinha-OEIS)  
W77-04483

**ONSHORE POLICY RESEARCH AND OFFSHORE OIL: A BRITISH PERSPECTIVE,**

Cook Coll., New Brunswick, N. J. Environmental Resources.

For primary bibliographic entry see Field 6G.

W77-04484

**ASSESSING THE VISUAL QUALITY OF THE COASTAL ZONE,**

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

For primary bibliographic entry see Field 6B.

W77-04485

**EDUCATION IN LAND USE DECISION MAKING,**

E-P Education Services, Hamden, Conn.

For primary bibliographic entry see Field 6B.

W77-04486

**COMMENTS ON FOOD AND ENERGY RESOURCES IN THE COASTAL ZONE,**

Federal Power Commission, Washington, D.C. Office of Energy Systems.

C. N. Shuster, Jr.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 263-269, 2 fig, 2 ref.

Descriptors: \*Land use, \*Multiple purpose, \*Resources development, Water resources, \*Natural resources, Coasts.

Identifiers: \*Coastal zone management, \*Energy sources, Food sources.

Food resources and energy supplies are comparable entities, 'feeding' individuals and societies, respectively. Coastal areas, traditionally sources of food, are increasingly utilized for other uses including energy supply systems. Since the coastal zone is finite, bases for coastal zone management decisions concerning food, energy supplies, and other resources are outlined. (See also W77-04462) (Sinha-OEIS)  
W77-04487

**ADVANCING TO THE REAR: A STRATEGY OF COASTAL ZONE MANAGEMENT ON ERODING SHORELINES (PRELIMINARY DISCUSSION),**

G. Soucie.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 270-274.

Descriptors: Water sources, \*Beach erosion, \*Shore protection, \*Resources development, \*Property values, Land use, Public rights, Government supports, Community development.

Identifiers: \*Coastal zone management.

Before establishing a setback line, passing zoning ordinances, and adopting land-use plans, the coastal community should take into account the

best available geologic and eustatic information, so that it can establish the setback line in a position that will not be threatened for a given number of years. The location of the setback line, and therefore the amount of safe time secured, will depend on the community's plans and zoning and on an optimization of amortization that has not been determined here. Landowners constructing homes or other structures along or behind the setback line would know approximately how long they could reasonably expect to have and use their properties, and the society and the responsible government would know how long it could afford to guarantee protection, how long it would be obligated to the property owners. (See also W77-04462) (Sinha-OEIS)  
W77-04488

**'ADJACENT STATES' RESPONSIBILITIES IN OUTER CONTINENTAL SHELF ACTIVITIES,**

Virginia Energy Office, Richmond.

For primary bibliographic entry see Field 5G.

W77-04489

**THE SURVIVAL OF SEWAGE BACTERIA AT VARIOUS OCEAN DEPTHS,**

Civil Engineering Lab. (Navy), Port Hueneme, Calif.

For primary bibliographic entry see Field 5B.

W77-04491

**A COST-EFFECTIVE SATELLITE-AIRCRAFT-DROGUE APPROACH FOR STUDYING ESTUARINE CIRCULATION AND SHELF WASTE DISPERSION,**

Delaware Univ., Newark. Coll. of Marine Studies.

For primary bibliographic entry see Field 5B.

W77-04492

**THE DELAWARE ESTUARY,**

Resources for the Future, Inc., Washington, D.C.

For primary bibliographic entry see Field 6G.

W77-04497

**APPLICATION OF MATHEMATICAL MODELS TO THE STUDY, MONITORING AND MANAGEMENT OF THE NORTH SEA,**

Liege Univ. (Belgium).

For primary bibliographic entry see Field 6G.

W77-04498

**RADIOCEIUM TRANSPORT IN THE HUDSON RIVER ESTUARY,**

New York University Medical Center, N.Y. Inst. of Environmental Medicine.

For primary bibliographic entry see Field 5B.

W77-04512

**THE COLLOIDAL NATURE OF RADIONUCLIDES IN SEAWATER,**

Rochester Univ., N.Y. Dept. of Radiation Biology; and Rochester Univ., N.Y. Dept. of Biophysics.

For primary bibliographic entry see Field 5B.

W77-04514

**AMERICIUM IN THE MARINE ENVIRONMENT-RELATIONSHIPS TO PLUTONIUM,**

Woods Hole Oceanographic Institution, Mass.

For primary bibliographic entry see Field 5C.

W77-04517

**THE BEHAVIOR OF PLUTONIUM NUCLIDES IN THE IRISH SEA,**

Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.

For primary bibliographic entry see Field 5C.

W77-04518

## Field 2—WATER CYCLE

### Group 2L—Estuaries

**PLUTONIUM FOODCHAINS,**  
Helsinki Univ., Finland. Dept. of Radiochemistry.  
For primary bibliographic entry see Field 5C.  
W77-04520

**TOWARD A GLOBAL MONITORING PROGRAM FOR TRANSURANICS AND OTHER MARINE POLLUTANTS,**  
Scripps Institution of Oceanography, La Jolla, Calif.  
For primary bibliographic entry see Field 5C.  
W77-04522

**LARVAE OF SOME FLAT FISHES FROM A TROPICAL ESTUARY,**  
Cochin Univ. (India). Dept. of Marine Sciences.  
K. P. Balakrishnan, and C. B. L. Devi.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland. May 17-23, 1973. p 677-684, 21 fig, 3 ref.

Descriptors: \*Systematics, \*Fish taxonomy, Larvae, Growth stages, Larval growth stage, Fish, Estuaries, Life history studies.  
Identifiers: Metamorphosis.

Larval stages of flat fishes were sorted out from formalin preserved plankton samples taken from Cochin Backwater. Larvae of *Solea heinii*, *Cynoglossus puncticeps*, *Cynoglossus brevis*, and *Cynoglossus cynoglossus* were examined and described in detail. It was concluded that most of the larvae of the tropical estuarine waters metamorphose before they attain a standard length of 4 to 5 mm. (See also W77-04524) (Chilton-ORNL)  
W77-04532

**THE FEASIBILITY OF OYSTER RAFT CULTURE IN EAST COAST ESTUARIES,**  
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.  
G. April, and D. Maurer.  
Aquaculture, Vol. 7, p. 147-160, 1976. 3 fig, 7 tab, 13 ref.

Descriptors: \*Oysters, \*Feasibility, \*Aquaculture, Economic efficiency, Growth rates, Mortality, Delaware, Northeast U.S., Estuaries, Size, Costs, Profit, Tidal waters, Fouling, Delaware Bay.  
Identifiers: \*Raft culture.

Styrofoam-floated oyster rafts were used in a 4-year project to study the applicability of raft culture to typical east coast tidal estuaries. Rafts were placed in Delaware Bay and several tidal rivers. Four types of cultch were tested for wear and for performance in attracting spat. Hatchery spawned oysters were reared on the rafts and their growth and mortality were monitored. Fouling was effectively controlled by air drying raft trays for 4 hours each week. Results showed that rafts anchored in the rivers had little structural degradation, but those anchored in the open waters of Delaware Bay were severely damaged by waves. While small tidal rivers offered the best physical characteristics required for raft culture, they often did not offer adequate biotic conditions, being affected by pollution or other suboptimal environments. Oysters grown on rafts reached market size in approximately two years in two of the rivers, and took longer in the other rivers. Between 60 and 70 of the oysters placed on rafts were lost during the two year period. An economic analysis indicated that a profit would be made only if 80% of the oysters could be harvested and the price was at least \$22 per bushel. It is concluded that raft culture will not become an accepted technique in the U.S. until prices increase or production costs substantially decrease. (Luedtke-Wisconsin)  
W77-04559

**THE ATLANTIC COAST SURF CLAM FISHERY—1973,**  
National Marine Fisheries Service, Oxford, Md.  
Middle Atlantic Coastal Fisheries Center.  
For primary bibliographic entry see Field 6C.  
W77-04565

**PIKE AS THE TEST ORGANISM FOR MERCURY, DDT AND PCB POLLUTION. A STUDY OF THE CONTAMINATION IN THE STOCKHOLM ARCHIPELAGO,**  
Naturhistoriska Riksmuseet, Stockholm (Sweden).  
For primary bibliographic entry see Field 5C.  
W77-04569

**OBSERVATIONS ON THE PROBLEMS OF POLLUTION IN SHATT AL-ARAB, IRAQ,**  
Alexandria Univ. (Egypt). Dept. of Oceanography.  
For primary bibliographic entry see Field 5B.  
W77-04575

**BACTERIAL DEGRADATION OF MOTOR OIL,**  
Maryland Univ., College Park. Dept. of Microbiology.  
For primary bibliographic entry see Field 5B.  
W77-04577

**THE GROWTH AND DISTRIBUTION OF TWO SPECIES OF LAURENCIA, A RED MACROALGA, IN CARD SOUND, FLORIDA,**  
Miami Univ., Coral Gables, Fla.  
For primary bibliographic entry see Field 5C.  
W77-04578

**YEAR-CLASS ABUNDANCE OF PELAGOPHILIC SUMMER-SPawning FISHES OF THE BLACK SEA AND FACTORS DETERMINING IT, (IN RUSSIAN),**  
Azovo-Chernomorskii Nauchno-Issledovatel'skii Instituti Morskogo Rybnogo Khozyaistva i Okeanografii, Kerch (USSR).  
R. M. Pavlovskaya.  
Vop Ikhniol 15(4), p 636-645, 1975.

Descriptors: \*Fish populations, \*Fish reproduction, \*Spawning, \*Environmental effects, Summer, Mullets, Schools(Fish), Fecundity.  
Identifiers: Egg quality, *Engraulis encrasicolus*, *Mugil*, *Mullus barbatus ponticus*, *Trachurus mediterraneus ponticus*, *Mullus barbatus ponticus* and *Mugil*.  
The effects of spawning school size, spawner fecundity, egg quality and environmental factors on the abundance of the year-class are discussed.—Copyright 1976, Biological Abstracts, Inc.  
W77-04579

The results of long-term investigation into the reproductive conditions and causes of dominant year-classes of the main commercial summer-spawning fishes of the Black Sea (USSR) (the anchovy *Engraulis encrasicolus ponticus*, horse-mackerel *Trachurus mediterraneus ponticus*, red mullet *Mullus barbatus ponticus* and mulle *Mugil*) are presented. The effects of spawning school size, spawner fecundity, egg quality and environmental factors on the abundance of the year-class are discussed.—Copyright 1976, Biological Abstracts, Inc.  
W77-04579

**BIOCHEMICAL COMPOSITION AND ENVIRONMENTAL CONDITIONS OF VENERUPIS DECUSSATA AND VENERUPIS PULLASTRA IN THE PASAJE ESTUARY, LA CORUNA, (IN SPANISH),**  
Instituto Espanol de Oceanografia, Madrid (Spain).  
For primary bibliographic entry see Field 5C.  
W77-04594

## 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

### 3A. Saline Water Conversion

**SANITARY-CHEMICAL EVALUATION OF CELLULOSE ACETATE MEMBRANES USED FOR DESALINATION OF SEA WATER, (IN RUSSIAN),**  
Scientific Research Inst. of Water Transport Hygiene, Moscow (USSR).  
Yu. B. Shafirov, and L. N. Larionova.  
Gig Sanit 7, p 110-111, 1975.

Descriptors: \*Desalination, \*Membranes, \*Membrane processes, \*Reverse osmosis, Waste water treatment, Sea water, Public health, Lethal limit.

Identifiers: Acetone, Cellulose acetate membranes, Formamide.

When cellulose acetate membranes treated with acetone and formamide are used in reverse osmosis desalination plants, these solvents will not enter fresh water in quantities exceeding 0.2-0.5 mg/l. No toxic functional or organic changes were found in rats receiving such desalinated water for 6 mo.—Copyright 1976, Biological Abstracts, Inc.  
W77-04596

### 3B. Water Yield Improvement

**WATER LOSS FROM SNOWDRIFTS UNDER OASIS CONDITIONS,**  
Wyoming Univ., Laramie. Water Resources Research Inst.

J. J. Fletcher, and P. A. Rechard.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 481, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, Wyoming Water Resources Series No. 63, September 1976. 85 p, 8 fig, 24 tab, 10 ref. OWRT B-021-WY05(5), 14-31-0001-4142.

Descriptors: \*Water loss, \*Water yield improvement, \*Snowpacks, \*Evaporation control, Snowmelt, Sublimation, Ablation, Snow management, Forecasting.

It may be feasible to increase the water supply in the western United States by modifying snow accumulation patterns. The results are reported that show that 65 to 90 percent of the initial water equivalent of snowdrifts could be recovered as runoff when allowed to ablate naturally. Use of a fiberglass mat to cover the drift extended the ablation period by 200 percent, thus causing the drift to act as a natural storage reservoir. Spraying the drift with an evaporation suppressant, Hexadecanol, significantly reduced evapo-sublimation loss, thereby causing a substantial increase in the total volume of runoff recovered from the water equivalent of the drift. Existing mass transfer models proved very unreliable in predicting evaporation loss from a snowdrift.  
W77-04174

**RESERVOIR YIELD USING TPM METHOD,**  
Ministry of Water Development, Salisbury (Rhodesia).

T. B. Mitchell.  
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol. 103, No. HY2, p 133-150, Proceedings paper No. 12748, February 1977. 5 fig, 7 tab, 2 ref, 4 appen.

Descriptors: \*Reservoir yield, \*Water yield, \*Probability, \*Hydrographs, \*Evaporation, Frequency, Markov processes, Simulation analysis, Statistics, Inflow, Equations, Methodology, Estimating, Systems analysis, Water storage.

## WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

### Use Of Water Of Impaired Quality—Group 3C

Identifiers: \*Transition probabilities, \*Probability theory, Matrices(Mathematics), Drawoff.

The use of the transition probability matrix (TPM) to estimate reservoir yield is suggested as an alternative to the generation of long sequences of simulated river flow. The theory of the TPM method is developed using the Markov process, and a numerical solution of a simple case of reservoir yield is presented. This solution is compared with an analytical solution. Allowance for evaporation can be conveniently included in the TPM method if a linear relation is assumed between water in storage and water surface area. Allowance for nonuniform inflow and drawoff can also be included if constant annual hydrographs or masks are used to describe these variables. It is shown that the TPM method of yield estimation can give accurate results when compared with the rigorous mathematical solution. (Bell-Cornell)  
W77-04505

**SOME ASPECTS OF COMPARATIVE LEAF ANATOMY OF SPECIES OF BROMELIACEAE (AECHMEA MEXICANA BAKOR AND HECHTIA GLOMERATA ZUCC., (IN SPANISH),**  
Costa Rica Univ., San Jose. School of Biology.  
For primary bibliographic entry see Field 2D.  
W77-04581

### 3C. Use Of Water Of Impaired Quality

**HERBICIDE MOVEMENT WITH WATER AND EFFECTS OF CONTAMINANT LEVELS ON NON-TARGET ORGANISMS,**  
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Plant Pathology and Physiology.  
For primary bibliographic entry see Field 5B.  
W77-04104

**USE OF CASPIAN SEA WATER FOR IRRIGATION,**  
O. G. Grammatikati, K. Omarov, D. Ramazanov, and Z. Shugaibov.  
Soviet Hydrology, Selected Papers, No. 2, p 106-110, November 1975. 5 fig, 4 tab. Translated from Gidrotekhnika i Melioratsiya, No. e p 94-99. 1975.

Descriptors: \*Irrigation, \*Sea water, \*Saline water, Salts, Sodium chloride, Ions, Irrigation effects, Crops, Laboratory tests, On-site investigations, Irrigation water, Salt tolerance, Leaching, Desalination, Soils, Foreign countries, Sands, Foreign research, Agriculture, Farm management. Identifiers: \*USSR, \*Caspian Sea.

As regards suitability for irrigation, sea water has several features that distinguish it from groundwater and drainage water with a high mineral content. In addition to harmful salts, sea water contains elements that are useful to plants and trace elements and substances that increase soil productivity. Most important is that, unlike groundwater and drainage water with a high mineral content, sea water is a well-balanced, ionic system in which the harmful effect of some of the ions is counterbalanced by the useful effect of other ions. According to the results of laboratory experiments, sunflower plants irrigated with sea water containing, in addition to other salts, 13 g NaCl/liter, developed normally. These plants died when irrigated with a pure NaCl solution in tap water (of the same concentration). This confirms the existence of an antagonism between ions in sea water, where the harmful effect of some ions is counterbalanced by the effect of other ions. Winter wheat and barley seeds germinate well in sea water. In plots with highly permeable Light-Chestnut medium loam soils, irrigation with Caspian Sea water, containing about 12.5 g of salts/liter, permits increasing the yield of alfalfa hay by

several factors and doubles the yield of winter wheat and barley as compared to the non-irrigated control. Positive results were obtained from irrigation with Caspian Sea water of decorative trees planted on sand in the coastal zone. After areas with permeable medium loam soils are irrigated with sea water, chloride and other salts accumulate in the upper soil layers (0-50 cm). Growing season irrigations at a high rate, alternating with irrigation at a normal rate, remove part of the salts. Additional desalination of the upper soil layer is achieved by winter precipitation. Salts accumulate in sand within permissible limits. The chloride content increases from 0.005 to 0.02% after irrigation with sea water, and the total amount of salts increases from 0.05 to 0.10%. (Sims-ISWS)  
W77-04263

**USE OF SALINE WATER IN AGRICULTURE. II. CROP GROWTH AND RESPONSE TO FERTILIZER APPLICATION UNDER SALINE WATER USE IN CULTIVATORS' FIELDS,**  
Central Arid Zone Research Inst., Jodhpur (India). R. P. Dhir, A. S. Kolkar, and S. N. Bhola.  
Annals of Arid Zone, Vol. 14, No. 4, p 277-284, December, 1975.

Descriptors: \*Irrigation practices, \*Nitrates, \*Fertilizers, \*Saline water, \*Crop response, Asia, Impaired water use, Irrigation, Irrigation water, Water utilization, Agriculture, Crop production, Nitrogen, Wells, Arid lands.

Identifiers: \*India, \*Rajasthan(India).

Highly saline and sodic waters are used extensively for irrigation in the arid lands of Western Rajasthan. Observations were made over a two-year period at several sites under irrigation with saline water from dug wells. Results indicate a trend of deterioration occurring in the condition of crops as the salinity of soil and water increased. The addition of nitrates improved crop production. To investigate further the beneficial effect of the presence of nitrate, crop growth in relation to salinity and nitrate content of irrigation waters was plotted. Results indicate that nitrates were beneficial at lower levels of salinity, but not effective at higher levels. The presence of naturally occurring nitrate in irrigation water has been found to be beneficial; where waters have lower values of nitrate, application of fertilizer results in higher yields. (See also W76-10168) (Jamail-Arizona)  
W77-04311

**SALT-RESISTANT CROPS COMING,**  
California Univ., Davis. Dept. of Plant Nutrition. D. W. Rush, J. D. Norly, and E. Epstein.  
Crops and Soils, Vol. 29, No. 3, p 7-9, December, 1976.

Descriptors: \*Sea water, \*Saline water, \*Plant growth, \*Irrigation water, \*Salt tolerance, Nutrients, Salinity, Saline water systems, Water types, Salts, Crops, Irrigation, Brackish water, Barley, Tomatoes, Wheat, Impaired water use.

Most plants on land depend on fresh water for growth, but salinity and plant life are not necessarily incompatible. Eleven of the thirteen mineral nutrients needed by plants are present in seawater in adequate concentrations for growing crops. Research was conducted to develop crops with a higher salt tolerance than present cultivated varieties. Irrigation water used contained more than ten times the usually accepted limit of salt. Only a few, less than ten percent, of the plants tested survived. Those that did were planted in the field in loamy sand with a deep profile and excellent water penetration. Because of this soil type there was no visible buildup of salt even after six months of seawater irrigation. Plants completed their life cycles and set viable seed in all treatments, even those irrigated with undiluted seawater. Although most experiments were conducted on barley, wheat and tomato plants were also included. (Jamail-Arizona)  
W77-04312

**EFFECT OF INDOLE ACETIC ACID PRESOAKING OF SEEDS AND THE QUALITY OF WATER APPLIED ON LEVELS OF AMINO ACIDS IN ARACHIS HYPOGEA,**  
Rajasthan Coll. of Agriculture, Udaipur (India). Dept. of Soil Science and Agricultural Chemistry. K. L. Totawat, and S. N. Saxena.  
Annals of Arid Zone, Vol. 14, No. 4, p. 302-307, December, 1976. 1 tab, 7 ref.

Descriptors: \*Seed treatment, \*Amino acids, \*Plant growth, \*Saline water, Seeds, Acids, Boron, Chromatography, Salts, Irrigation, Irrigation water, Irrigation effects, Electrical conductance, Conductivity, Alkaline water, Water quality.

Identifiers: \*Indole acetic acid, \*Growth regulators, \*Rajasthan(India).

The use of saline irrigation water adversely affects the growth and composition of plants, but it is used in some areas of India in the absence of any other source for irrigation. Little is known about the effect of growth regulators on field crops under cultivation in areas irrigated by saline water. In this study the effect of presoaking seeds with indole acetic acid was evaluated: plants from *Arachis Hypogea* seeds soaked in indole acetic acid were grown in sandy loam soil, and levels of amino acids in the leaves and stems of these plants, grown under greenhouse conditions, and the quality of water were determined by paper chromatography. While treatment with indole acetic acid depressed the levels of some of the amino acids, increasing levels of electrical conductivity, sodium adsorption ratio, and boron concentration in water tended to increase the amino acid levels. (Jamail-Arizona)  
W77-04318

**DESALINATION OF SOILS OF MENOFEA GOVERNORATE PUT UNDER TILE DRAINAGE,**  
Ain Shams Univ., Cairo (Egypt). Dept. of Soils; and Ain Shams Univ., Cairo (Egypt). Faculty of Agriculture.  
For primary bibliographic entry see Field 2G.  
W77-04322

**LEACHING OF SALINE SOILS IN MONOLITHS OF IRAQ,**  
Cairo Univ., Giza (Egypt). Dept. of Soils.  
For primary bibliographic entry see Field 2G.  
W77-04324

**THE INFLUENCE OF SOIL WARMING WITH WASTE HEATED WATER ON SWEET POTATO GROWTH, DEVELOPMENT, AND ROOT QUALITY,**  
North Carolina State Univ., Raleigh. Dept. of Horticultural Science; and North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering. D. C. Sanders, W. C. Porter, R. W. Skaggs, and D. M. Scheirer.  
Article submitted to Journal of Environmental Quality, 1975. 5 tab, 12 tab, 12 p. 6 ref. OWRA-060-NC(5).14-31-0001-4033.

Descriptors: \*Soil temperature, \*Cooling water, \*Heated water, \*Sweet potatoes, Productivity, Heat transfer, Horticultural crops, North Carolina, Subsurface irrigation.  
Identifiers: \*Soil warming, \*Waste heat, Evaporative cooling.

The influence of soil warming, subirrigation, evaporative cooling irrigation and all combinations of these environmental modifications were evaluated on the growth, development and root quality of 2 cultivars of sweet potato (*Ipomoea batatas* (L.) Lam.). During a one year preliminary study the fresh and dry weight of the above ground plant material was increased with soil warming. The total yield of roots was not affected by soil warming.

### Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

#### Group 3C—Use Of Water Of Impaired Quality

ing. Roots tended to be larger when soil warming was practiced. The intensity of root epidermis color was reduced with soil warming, but the internal color was improved. Percent dry weight and pH of the roots were reduced with soil warming. After 3 weeks storage internal color was no longer influenced by soil warming, but pH was still lower than roots from non-warmed soil. Evaporative cooling reduced the foliage weight, storage root fresh weight and total weight of Jewel but not of Copperskin Jewel. (Stewart-NC State) W77-04395

**INVENTORY OF WASTE WATER PRODUCTION AND WASTE WATER RECLAMATION IN CALIFORNIA 1973.**  
California Dept. of Water Resources, Sacramento, Water Quality Section.  
For primary bibliographic entry see Field 5D. W77-04558

**EFFECT OF WATER QUALITY AND IRRIGATION FREQUENCY ON FARM INCOME IN THE IMPERIAL VALLEY,**  
California Univ., Davis. Dept. of Agricultural Economics.  
J. Noel, C. V. Moore, F. Robinson, and J. H. Snyder.  
California Agriculture, Vol. 29, No. 11, p. 12-14, 1975. 2 tab.

Descriptors: \*Income, \*Irrigation, \*Saline water, \*Irrigation water, \*California, Brackish water, Salt tolerance, Water quality, Farm prices, Farm units, Irrigation programs, Water distribution(Applied), Economics, Model studies, Agronomy, Crop response, Farm management, Leaching, Soil types.  
Identifiers: \*Irrigation frequency, \*Imperial Valley(Calif).

In a study undertaken to identify the effects of increasing salinity and changing water supply on farm net revenue and cropping patterns in the Imperial Valley of California, a linear model was developed to select the optimum cropping patterns and irrigation frequencies to maximize net farm income under variations in water quantity and quality. The model was used to project significant shifts in cropping patterns as the salt content of irrigation water increased. A substitution effect appears between water quality and the quantity of water applied, through both higher leaching fractions and more frequent irrigation. At high irrigation water salinity levels, lighter and better-drained soils maintain their productivity and therefore their agricultural value as compared with heavy clay soils. Finally, decreased yields and higher use per acre of crops planted are projected to have a negative effect on farm incomes in the Valley as salt content of the Colorado River increases. The experiment from which the model was developed utilized first-order crop response approximations in which six different water salinity levels were tested with five irrigation frequencies and four soils. (Harris-Wisconsin) W77-04566

#### 3D. Conservation In Domestic and Municipal Use

**LAND USE PLANNING: IMPORTANT TOOL FOR CONTROLLING WATER DEMANDS,**  
Metcalf and Eddy, Inc., Boston, Mass.  
For primary bibliographic entry see Field 6D. W77-04173

**DEVELOPMENT CAPABILITIES MAPS, SOUTHEASTERN NEW ENGLAND. WATER AND RELATED LANDS STUDY.**  
New England River Basins Commission, Boston, Mass.  
For primary bibliographic entry see Field 7C. W77-04206

#### 3E. Conservation In Industry

**SUCROSE REMOVAL FROM CANE SUGAR MILL WASTE STREAMS BY ION EXCHANGE,**  
Louisiana Water Resources Research Inst., Baton Rouge.  
For primary bibliographic entry see Field 5D. W77-04142

**ROLE OF THE HEAT STORAGE WELL IN FUTURE U.S. ENERGY SYSTEMS,**  
General Electric TEMPO, Santa Barbara, California, Center for Advanced Studies.  
For primary bibliographic entry see Field 4B. W77-04145

**ISSUES AND OPINIONS ON THE SOCIAL EFFECTS OF WATER ALLOCATION FOR COAL DEVELOPMENT IN THE YELLOWSTONE RIVER DRAINAGE,**  
Montana State Univ., Bozeman.  
For primary bibliographic entry see Field 6B. W77-04146

**PROCESS AND ENVIRONMENTAL TECHNOLOGY FOR PRODUCING SNG AND LIQUID FUELS,**  
M. R. Beychok.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-242 774, Price codes: A08 in paper copy, A01 in microfiche. Prepared for the Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory, National Environmental Research Center, Ada, Oklahoma, May 1975. 143 p, 14 fig, 16 tab. EPA-660/2-75-011, 68-03-2136.

Descriptors: \*Environmental control, \*Coals, Oil, \*Oil shales, \*Environmental engineering, \*Technology, \*Water requirements, \*Industrial production, \*Natural gas, Coal mine wastes, Air pollution, Water pollution, Water discharge.  
Identifiers: \*Substitute natural gas(SNG), \*Liquified natural gas(LNG), Liquification, Gasification, \*Methanol, Blowdowns, Environmental quality, Water disposition.

The report explains processes and technology currently available for (1) producing substitute natural gas (SNG) from coal, crude oil and naphtha, (2) transport of gas supplies in the form of liquified natural gas (LNG) or as liquid methanol and regassification of LNG, (3) the conversion of coal into low sulfur oil, and (4) the production of low-sulfur oil from oil shale. Written for agencies concerned with environmental regulations for industries producing and transporting alternative energy supplies, environmental factors of the process technologies are emphasized rather than detailed technical design factors. Production technology is analyzed to determine environmental variables such as heat balances, combustion, stack gas and emissions, and water balances, including effluent water discharge (blowdowns and wastewater). Key environmental factors for each technology discussed are: (1) SNG from LPG and/or naphtha—combustion stack gas, CO<sub>2</sub> vent gas, and effluent water discharges (blowdowns and wastewater); (2) SNG from coal—thermal efficiency, SO<sub>2</sub> emissions to the air, water consumption and deposition, mining operations and subsequent land reclamation; (3) SNG from crude oil—thermal efficiency, water consumption and deposition, and SO<sub>2</sub> emissions; (4) LNG (Liquification at source)—thermal efficiency; (5) LNG (Gasification at market)—thermal efficiency; (6) methanol fuel—large fresh water usage for cooling; (7) liquid fuels from oil shale—SO<sub>2</sub>, NO<sub>x</sub> and particulate emissions, water requirement and deposition, spent shale disposal, and mining impacts; (8) coal liquification and gasification—specific information depends on the technology used. (Gentry-NC) W77-04204

described in the report. The report also discusses the environmental impact of each technology, including the effects on air quality, water resources, and land use. The report concludes with recommendations for further research and development in the field of energy production from coal and oil shale.

**EFFECT OF INDUSTRIAL ACTIVITY ON RIVER RUNOFF IN THE CENTRAL URAL,**  
For primary bibliographic entry see Field 4C. W77-04258

**POTENTIAL IMPACT OF THE DEVELOPMENT OF LIGNITE RESERVES ON WATER RESOURCES OF EAST TEXAS,**  
Texas A and M Univ., College Station. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5B. W77-04297

**WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: CATEGORY 29 INSULATION FIBERGLASS,**  
Battelle Memorial Inst., Columbus, Ohio.  
For primary bibliographic entry see Field 5G. W77-04300

**WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: CATEGORY 16 PAINT AND INK FORMULATION AND PRINTING,**  
Battelle Memorial Inst. Columbus, Ohio.  
For primary bibliographic entry see Field 5G. W77-04301

**WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES CATEGORY 7, DAIRY PRODUCTS,**  
Battelle Memorial Inst., Columbus, Ohio.  
For primary bibliographic entry see Field 5G. W77-04302

**WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: INDUSTRY CATEGORY 1A, ORE MINING AND MILLING,**  
Battelle Memorial Inst., Columbus, Ohio.  
For primary bibliographic entry see Field 5G. W77-04303

**WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, DIRECT AND CUMULATIVE INDUSTRY IMPACTS,**  
Development Planning and Research Associates, Inc., Manhattan, Kans.  
For primary bibliographic entry see Field 5G. W77-04304

**CLOSED LOOP WATER RECYCLING SYSTEM SOLVES WASTE PROBLEM,**  
Mogul Corp., Chagrin Falls, Ohio.  
For primary bibliographic entry see Field 5D. W77-04453

**CONCENTRATION OF OILY AND LATEX WASTE WATERS USING ULTRAFILTRATION INORGANIC MEMBRANES,**  
For primary bibliographic entry see Field 5D. W77-04454

**OXYGEN/ALKALI DELIGNIFICATION AT KAMYR DIGESTER BLOWLINE CONSISTENCY — A STATUS REPORT,**  
Peterson and Son, Moss (Norway).  
For primary bibliographic entry see Field 5D. W77-04456

**BASIN AGENCIES AND THE FIGHT AGAINST INDUSTRIAL POLLUTION (LES AGENCE DE BASSIN ET LA LUTTE CONTRE LA POLLUTION INDUSTRIELLE),**  
For primary bibliographic entry see Field 5D. W77-04457

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Control Of Water On The Surface—Group 4A

**REMOVAL OF SULFATE FROM INDUSTRIAL WASTE WATERS,**  
Commonwealth Scientific and Industrial Research Organization, Belmont (Australia). Div. of Textile Industry.  
For primary bibliographic entry see Field 5D.  
W77-04458

#### 3F. Conservation In Agriculture

**IRRIGATION WELL EFFICIENCY,**  
Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources.  
For primary bibliographic entry see Field 8B.  
W77-04292

**MAKING WATER AVAILABLE FOR IRRIGATION,**  
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 4B.  
W77-04293

**INFLUENCE OF TEMPERATURE REGIMES AND WATER STRESS ON THE GERMINATION OF THREE RANGE GRASSES AND ITS POSSIBLE ECOLOGICAL SIGNIFICANCE TO A SHORTGRASS PRAIRIE,**  
Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.  
U. G. Bokhari, J. S. Singh, and F. M. Smith.  
Journal of Applied Ecology, Vol. 12, No. 1, p 153-163, April, 1975. 5 fig, 2 tab, 14 ref.

Descriptors: \*Range grasses, \*Range management, \*Germination, \*Soil water, \*Soil temperature, Grama grasses, Wheatgrasses, Grasses, Seeds, Plant physiology, Moisture stress, Stress, Soil water movement, Evapotranspiration, Moisture, Soil moisture, Water balance, Soil-water-plant relationships, Colorado.  
Identifiers: Pawnee National Grassland(Colo).

The influence of three temperature regimes and seven levels of soil water stress in each temperature regime on the germination of three grasses was studied, and the soil temperature and water stress in a shortgrass prairie at the Pawnee National Grassland were analyzed to investigate whether conditions established experimentally as suitable for germination actually exist in nature, and if so, for how long and how often within a given year. Growth chamber experiments were conducted and the results presented. To accompany the germination experiments, actual measurements of soil temperature and soil water representative of a shortgrass prairie were utilized to examine the number and length of periods favorable for germination in 1972. Three species were examined: blue grama, buffalo grass and western wheatgrass. Blue grama and buffalo grass seeds are more susceptible to low temperature, even with relatively little water stress. Western wheatgrass seeds can withstand greater water stress at low temperatures. (Jamail-Arizona)  
W77-04313

**STUDIES ON THE RATES OF WATER USE OF DWARF WHEAT AND THEIR RELATIONSHIP WITH POTENTIAL VALUES BASED ON THE CLIMATOLOGICAL APPROACH,**  
Punjab Agricultural Univ., Kapurthala (India). Rice Research Station.  
H. N. Shahi.  
Plant and Soil, Vol. 45, No. 1, p 57-63, August, 1976. 2 fig, 3 tab, 8 ref.

Descriptors: \*Water utilization, \*Consumptive use, \*Crop response, \*Moisture meters, \*Climatology, Asia, Wheat, Evapotranspiration, Semiarid climates, Meteorology, Irrigation, Irrigation water, Irrigation practices, Irrigation efficiency, Soil moisture, Moisture content, Root zone, Evaporation, Plant growth.

Field studies were conducted to assess consumptive use of water by dwarf wheat, both seasonal and at different stages of crop growth, under semiarid conditions and to compare the results with values obtained by various formulae using meteorological parameters. Six irrigations were applied during the growth period. The first was given three weeks after sowing and subsequent irrigations when about 50 percent of the available soil moisture was depleted. Results show that the daily rate of water use by wheat was quite low during the early part of growth, gradually increased up to ear emergence and grain development, and declined towards maturity. Potential evapotranspiration as calculated by the Thornthwaite formula was found to be an unreliable estimate for evapotranspiration. Evaporation from the U.S. open pan evapotranspiration gave values closer to actual rates, except during maturity. Ramdas' values were not close to actual water use rates; Penman's formula gave values closer to the field water use rates. Consumptive use calculated by the Blaney-Criddle method did not give an appropriate estimate for all months tested. (Jamail-Arizona)  
W77-04314

**DRIP IRRIGATION AN EFFICIENT TECHNIQUE,**  
Indian Agricultural Research Inst., Coimbatore. Regional Station.  
K. Shanmugham, P. C. Meenakshisundaram, and V. Seshadri.  
Indian Farming, Vol. 26, No. 1, p. 15-17, April, 1976.

Descriptors: \*Irrigation systems, \*Irrigation efficiency, \*Water costs, Irrigation, Flood irrigation, Surface irrigation, Sprinkler irrigation, Seepage, Percolation, Water conservation, Irrigation practices, Irrigation water, Impaired water use, Saline water, Crop production, Furrow irrigation.  
Identifiers: \*Trickle irrigation, \*Drip irrigation.

Economic use of water is an absolute necessity in areas where water resources are scarce. In conventional flood irrigation through open channels, much of the water is lost by seepage and percolation. The efficiency of drip or trickle irrigation is discussed and evaluated. Drip irrigation involves the slow release of water in drips at points where plants grow, in quantities not more than what is essential for their normal growth. Field experiments were conducted in India to compare the efficiency of drip irrigation with conventional irrigation. The results showed that the drip method of irrigation was more advantageous than conventional furrow irrigation. The advantages include: (1) higher yield with less water, (2) minimized water loss through surface evaporation or runoff, (3) checked weed growth, (4) utilization of saline water, and (5) the method can be used in poor sandy soils and in areas of uneven topography. Drip irrigation in the Indian experiment cut irrigation and fertilizer cost by one-half. Once installed, the drip irrigation system can be used without disturbance for at least four years. (Jamail-Arizona)  
W77-04315

#### 4. WATER QUANTITY MANAGEMENT AND CONTROL

##### 4A. Control Of Water On The Surface

**PUBLIC INFORMATION ON WATER RESOURCES IN THE LAKE ERIE TRIBUTARY BASIN OF NORTHERN OHIO: CONTENT AND EXPOSURE,**  
Ohio State Univ., Columbus. School of Journalism.  
For primary bibliographic entry see Field 6B.  
W77-04101

**NEW MEXICO WATER RESOURCES, ASSESSMENT FOR PLANNING PURPOSES,**  
Bureau of Reclamation, Amarillo, Tex. S Region 5.  
For primary bibliographic entry see Field 6B.  
W77-04112

**ARID BASIN MANAGEMENT MODEL WITH CONCURRENT QUALITY AND FLOW CONSTRAINTS-PHASE II,**  
Nevada Univ., Reno. Desert Research Inst.  
For primary bibliographic entry see Field 2A.  
W77-04147

**WATER RESOURCES RESEARCH IN THE LOWER COLORADO RIVER BASIN, 1972-1976,**  
Nevada Univ., Reno. Desert Research Inst.  
E. N. Cooper, D. K. Lyon, K. L. DeCook, K. Foster, and C. Scherer.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 487, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, August 1976. 186 p, 2 fig. OWRT X-151(No. 5262)(1).

Descriptors: \*Colorado River basin, \*Bibliographies, Information exchange, Information retrieval, Research and development, Water resources development.

Identifiers: \*Lower Colorado River, Technology transfer, Information dissemination.

Current and recent research (1972-1976) concerning water resources in the Lower Colorado River Basin is abstracted and compiled into a bibliography of 283 references. Data were gathered by contacting research personnel and requesting information via questionnaire. The report is indexed by principal investigator, keyword and funding source. In addition, the project descriptions are contained in a computerized data file and easily accessed by contacting the Office of Arid Lands Studies, University of Arizona, Tucson, AZ. The information can be retrieved by keyword, principal investigator, state, funding source and geographic location.  
W77-04148

**ANALYZING THE MARGINAL COST OF WATER SUPPLY,**  
International Labour Office, Geneva (Switzerland).  
For primary bibliographic entry see Field 6B.  
W77-04170

**LEGAL ASPECTS OF LAND USE REGULATION OF LAKE SHORELANDS BY STATE AND LOCAL GOVERNMENTS FOR THE PROTECTION OF LAKES,**  
Texas Univ. at Austin. Center for Research in Water Resources.  
For primary bibliographic entry see Field 6E.  
W77-04175

**OPTIMIZATION MODEL FOR THE DESIGN OF URBAN FLOOD-CONTROL SYSTEMS,**  
Texas Univ. at Austin. Center for Research in Water Resources.  
For primary bibliographic entry see Field 2E.  
W77-04179

**THE NATIONAL FLOOD INSURANCE PROGRAM-A MODEL ORDINANCE FOR IMPLEMENTATION OF ITS LAND MANAGEMENT CRITERIA,**  
Florida Univ., Gainesville. School of Law.  
For primary bibliographic entry see Field 6F.  
W77-04186

**AN ANALYSIS OF THE INTERNATIONAL GREAT LAKES LEVELS, BOARD REPORT ON**

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4A—Control Of Water On The Surface

**REGULATION OF GREAT LAKES WATER LEVELS. HYDROLOGY,**  
Wisconsin Univ., Madison. Inst. for Environmental Studies.

For primary bibliographic entry see Field 2H.  
W77-04191

**WORKSHOP REPORT INTEGRATING WATER QUALITY AND WATER AND LAND RESOURCES PLANNING.**

For primary bibliographic entry see Field 6B.  
W77-04202

**SYMPOSIUM, THE FUTURE OF CHESAPEAKE BAY.**

For primary bibliographic entry see Field 6G.  
W77-04203

**CONNECTICUT RIVER BASIN, SUPPLEMENTAL STUDY, NEW HAMPSHIRE, VERMONT, MASS. AND CONN. THE RIVER'S REACH. PHASE II. LAND USE CHANGES IN SELECTED FLOOD PLAINS,**

Economic Research Service, Broomall, Pa.

R. J. Glass, and J. Wenderoth.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-246 803, Price codes: A03 in paper copy, A01 in microfiche. Final Report. July 1975. 22 p, 7 tab, 2 append. CRSS-NERBC 2.1B, NERBC 2.1B.

Descriptors: \*Land use, \*Flood plain, \*Non-structural alternatives, \*Agriculture, \*Forests, \*Grasslands, \*Water resource development, \*Massachusetts, Flood control, Dams, Reservoirs, Zoning, Flood insurance, Flood proofing. Identifiers: \*Connecticut River, \*Flood plain management, \*Westfield River, \*Mill River, Standard Project Flood.

Land use changes with special emphasis on agricultural lands in the flood plains of the Connecticut, Westfield and Mill Rivers in Franklin, Hampshire and Hampden Counties, Mass. were examined. A sampling technique was used to compute 1952 and 1972 land use acreage in flood plains as defined by the Standard Project Flood for the Connecticut and Westfield Rivers and by the 100-year flood for Mill River. Land use categories were agricultural, urban, water and wetlands, forest and abandoned land. In the total area, urban and forest land use increased in acreage from 1952 to 1972 while the other three declined. Structural flood plain management measures (dry-bed reservoirs and dikes were considered) would not have much effect on current agricultural land use. Non-structural alternatives discussed included flood damage insurance, flood proofing, relocation of buildings and land use regulation. Agricultural land, forest and grasslands are compatible with the flood plain and provide valuable storage capacity. Decline in agricultural acreage resulted from competition for land, the changing technology of agricultural production, inter-regional competition, competition for human resources, and high property taxes. Policies which restrict urban development in flood plains or make it more costly will have the tendency of reducing land competition, and therefore create a situation more desirable for extensive land uses. (Gentry-NC)  
W77-04205

**DEVELOPMENT CAPABILITIES MAPS, SOUTHEASTERN NEW ENGLAND. WATER AND RELATED LANDS STUDY.**

New England River Basins Commission, Boston, Mass.  
For primary bibliographic entry see Field 7C.  
W77-04206

**FLOOD PLAIN INFORMATION: MARICOPA COUNTY, ARIZONA, VOLUME III, SKUNK CREEK REPORT.**

Army Engineer District, Los Angeles, Calif.

Prepared for Maricopa County and Flood Control District of Maricopa County, March 1965. 32 p, 4 fig, 13 plates, 3 append, 10 ref.

Descriptors: \*Arizona, \*Floods, \*Flood profiles, \*Flood plains, Design flood, Storms, Cloudbursts, Flood frequency, Peak discharge, Non-structural alternatives, Flood plain zoning, Building codes, Channel improvement.

Identifiers: Maricopa County(AZ), \*Skunk Creek(AZ), \*50-year flood, \*100-year flood, Standard Project Flood.  
W77-04211

extensive damage. The IRF would rise to peak in 56 hours and last 67 hours above bankfull capacity, while the SPF would rise in 55 hours and last 84 hours. This report is intended to aid in a floodplain management program using land use planning, building codes and zoning regulations. (Salzman-North Carolina)

W77-04211

**FLOOD PLAIN INFORMATION: LITTLE ARKANSAS RIVER AND BLACK KETTLE CREEK, HALSTEAD, KANSAS.**

Army Engineer District, Tulsa, Okla.

Prepared for the City of Halstead, KA., June 1974. 32 p, 9 fig, 11 plates, 5 tab.

Descriptors: \*Kansas, \*Floods, \*River forecasting, \*Flood profiles, \*Flood damage, \*Flood plains, \*Non-structural alternatives, Floodwater, Flood flow, River flow, Streamflow forecasting, Historic floods, Flood data, Peak discharge, Flow duration, Obstruction to flow, Levee.

Identifiers: Standard Project Flood, Intermediate regional flood, Halstead(KA), \*Little Arkansas River(KA), \*Black Kettle Creek(KA).

Halstead (population 1,700) is a center for farm supplies and services. The town is expected to continue to grow. Black Kettle Creek, with a drainage area of 43 sq mi, is a tributary of the Little Arkansas River, drainage area 888 sq mi. The stream valleys are relatively flat and wide and the combined flood plain width of the two streams averages 2 miles. Most flood producing storms occur in this basin during April through September. Seven major floods have occurred since 1904; the largest in 1951 caused considerable damage in Halstead and left many people homeless. In 1973 another major flood inundated the entire business section and many houses. In an Intermediate Regional Flood (IRF) peak discharges of about 55,000 cubic feet per second is expected at the lower limit of the study area. The Intermediate Regional Flood would have a discharge of 24,000 cfs. Information in the form of maps and profiles is given on the limits of the SPF, IRF and 50-year magnitude floods. No flood control works are in this area and no floodplain zoning regulations are in effect. A limited amount of channel improvement has been undertaken. In this report guidelines for reducing future flood damages are given. (Smith-North Carolina)

W77-04210

**FLOOD PLAIN INFORMATION: HOCKING RIVER, ATHENS, OHIO.**

Army Engineer District, Huntington, W. Va.

Prepared for State of Ohio, Department of Natural Resources. January 1972. 39 p, 13 fig, 13 plates, 7 tab.

Descriptors: \*Ohio, \*Floods, \*Flood profiles, \*Flood plains, Streamflow forecasting, Flood data, Peak discharge, Channel improvements, Non-structural alternatives, Control structures.

Identifiers: \*Hocking River(OH), Athens(OH), Nelsonville(OH).

This report concerns flood conditions along 8.2 miles of the Hocking River which flows southeast through Athens at an average slope of 2 ft per mile. It drains 950 sq mi above the study area. Considerable development of the University of Ohio and residential development have encroached on the floodplain. Pressure to develop increases. Most floods occur during the winter and spring months or are caused by intense summer thunderstorms. Duration of flooding is relatively long due to large drainage areas upstream, flat gradient in the study area and the fact that tributary streams reach peak discharges and stages at approximately the same time as the main stream flow. Hazardous conditions result from high velocities of 6 ft/sec in channel, deep flows and prolonged period of flooding. Flood damage prevention measures include channel improvements (straightening, realining and enlarging the channel), raising of floodplain land and adoption of limited floodplain regulations. The greatest flood occurred in 1907. Peak discharge was 50,000 cubic feet per second. Damage in a 1964 flood was \$610,000. Peak discharges of 46,000 cfs for an Intermediate Regional Flood (IRF) and 103,500 cfs for a Standard Project Flood (SPF) would cause

extensive damage. The IRF would rise to peak in 56 hours and last 67 hours above bankfull capacity, while the SPF would rise in 55 hours and last 84 hours. This report is intended to aid in a floodplain management program using land use planning, building codes and zoning regulations. (Salzman-North Carolina)

extensive damage. The IRF would rise to peak in 56 hours and last 67 hours above bankfull capacity, while the SPF would rise in 55 hours and last 84 hours. This report is intended to aid in a floodplain management program using land use planning, building codes and zoning regulations. (Salzman-North Carolina)

W77-04211

**FLOOD PLAIN INFORMATION: NORTH PLATTE, NEBRASKA; NORTH PLATTE RIVER AND SOUTH PLATTE RIVER.**

Army Engineer District, Omaha, Nebr.

Prepared for City of North Platte and Nebraska Natural Resources Commission, June 1973. 23 p, 8 fig, 14 plates, 6 tab.

Descriptors: \*Floods, \*Flood profiles, \*Flood plains, \*Control structures, \*Nebraska, Flood flow, Streamflow forecasting, Flood forecasting, Peak discharge, Snowmelt, Levee, Reservoirs.

Identifiers: \*North Platte River(NB), \*South Platte River(NB), North Platte(NB), Standard Project Flood, Intermediate Regional Flood.

Land in the floodplains of this study area include residential and commercial developments, but is primarily agricultural at present. There is pressure to continue developing in flood prone areas and large floods are possible. At the confluence of the North and South Platte Rivers, about 4 mi

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Control Of Water On The Surface—Group 4A

southeast of North Platte, NB, the combined drainage areas of the rivers is 59,200 sq mi. Most of the city lies between the rivers and almost all of it is subject to flooding which can last for several days. The floodplains of the rivers vary from 5,500 to 13,100 ft in width. There is higher ground suitable for development; the city originated on the floodplain and has continued to grow there. It is expected that floodplains will continue to be encroached upon unless control measures are imposed. Heavy rains combined with snowmelt, or snowmelt alone, can cause flooding. Peak flows generally occur in March through October. No record of floods exist for North Platte, but gaging records indicate that the estimated 7,000 cubic ft/sec capacity of the channel of the North Platte River has been exceeded numerous times. The 20,000 to 30,000 cfs capacity of the South Platte River has been exceeded only once. In an Intermediate Regional Flood, peak discharges of 13,500 and 60,000 cfs are predicted on the North Platte and South Platte Rivers, respectively. In a Standard Project Flood, peak discharges of 35,400 and 98,000 cfs are anticipated for the 2 rivers. Four bridges in the area will obstruct flood flows. Reservoirs on both rivers reduce flood waters, and levees in the area provide some protection. (Smith-North Carolina)  
W77-04213

**FLOOD PLAIN INFORMATION: SIOUX CITY, IOWA, VOLUME I, PERRY CREEK.**  
Army Engineer District, Omaha, Nebr.  
Prepared for the Iowa Natural Resources Council and the City of Sioux City, October 1973. 40 p, 18 fig, 11 plates, 7 tab.

Descriptors: \*Floods, \*Flood plains, \*Channel improvements, \*Non-structural alternatives, \*Channels, \*Flood profiles, \*Iowa, Land use, Peak discharges, Control structures, Flow characteristics.  
Identifiers: Sioux City(IA), \*Perry Creek(IA), Flood plain management program, \*Hanford Creek(IA), Sunnybrook Creek(IA), Riprap, Retaining walls.

The portion of Sioux City covered by this report is subject to flooding from 6.5 miles of Perry Creek, a tributary of the Missouri River, and two tributaries, Hanford Creek and Sunnybrook Creek. Flood plains average 1800 feet wide. Land uses in the flood plains, which are 80% developed, are commercial, residential and agricultural with rising pressure to develop. Intermittent stretches of the main channel of Perry Creek have been straightened upstream from an underground conduit which covers about 3000 feet. Channel banks have been stabilized with riprap or retaining walls. Predominant cause of flooding is heavy rainfall during May through September. Floods peak in about 4 hours and rarely last more than 12 hours. Twenty bridges may cause obstructions to flood flow. The Corps of Engineers has developed a plan of improvements consisting of a system of dams, reservoirs and downstream channel modifications. No flood regulations now exist; however, the Soil Conservation Service has developed a watershed work plan. The most damaging flood, on July 7 1944, had a discharge of 9,600 cubic feet per second. An Intermediate Regional Flood (IRF) and Standard Project Flood (SPF) have estimated discharges of 20,000 cfs and 39,200 cfs respectively which would create extensive damages and flood hazards. This report furnishes suitable bases for identifying flood damaging reduction techniques needed to develop a Flood Plain Management Program. (Salzman-North Carolina)  
W77-04214

**FLOOD PLAIN INFORMATION: STEAMBOAT CREEK AND TRIBUTARIES, STEAMBOAT AND PLEASANT VALLEYS, NEVADA.**  
Army Engineer District, Sacramento, Calif.  
Prepared for Regional Planning Commission of Reno, Sparks, and Washoe County, June 1972. 40 p, 18 fig, 22 plates, 6 tab.

Descriptors: \*Nevada, \*Floods, \*Flood profiles, \*Flood plains, Flash flood, Streamflow forecasting, Maximum probable flood, Cloudbursts, Flood data, Peak discharge, Flood damage, Stream erosion, Deposition(Sediments), Erosion control.  
Identifiers: \*Steamboat Creek(NV), Galena Creek(NV), \*Bailey Canyon Creek(NV), Steamboat Valley(NV), Pleasant Valley(NV), Standard Project Flood, Intermediate Regional Flood.

In the floodplains of this study area, land is primarily used for cattle ranching and production of livestock feed, though there are scattered rural residences. Some subdivision-type development has taken place in Pleasant Valley and along Bailey Canyon Creeks, which drain 19.5 and 15.9 sq mi, respectively, and are tributaries of Steamboat Creek which drains 83.8 sq mi at the lower limit of the study area. Floods occur October through March after prolonged heavy rain and during summer months after a cloudburst. Several floods in the 1950s and 1960s are thought to have been very severe, though actual flood records are very limited. Peak recorded discharge on Steamboat Creek is 1,000 cubic ft/sec in 1963 and 3,670 cfs on Galena Creek. Damages to agricultural lands and deposition of silt has been a problem in some locations. In an Intermediate Regional Flood peak discharges of 8,100 cfs, 6,000 cfs and 4,600 cfs are predicted on Steamboat, Galena and Bailey Canyon Creeks, respectively, along with water velocities of 8 ft/sec on Steamboat Creek, 10 ft/sec on Galena Creek and 12 ft/sec on Bailey Canyon Creek. Floods would rise to peak in 1 to 5 hours and remain at critical stage up to 10 hours. In a Standard Project Flood, peak discharges of 15,500 cfs, 11,500 cfs and 6,200 cfs are anticipated on the three creeks, respectively. Almost all of the 12 bridges across these streams would be obstructive to major flood flows. No flood control projects have been undertaken in this area, but the Soil Conservation Service has undertaken some watershed protection projects. There are no floodplain zoning regulations. (Smith-North Carolina)  
W77-04215

**FLOOD PLAIN INFORMATION: SAND AND COTTONWOOD CREEKS AND THE LOWER KAWEAH RIVER, VISALIA, CALIFORNIA.**  
Army Engineer District, Sacramento, Calif.

Prepared for Tulare County, May 1972. 66 p, 48 fig, 60 plates, 8 tab.

Descriptors: \*Floods, \*Flood plains, Floodwater, \*Flood data, \*Flood profiles, Dams, Runoff, Flood forecasting, Storms, Historic floods, Flood frequency, Flood stages, Peak discharge, Flow characteristics, Frail lands, Snowmelt, Channels, Flood plain zoning, Reservoirs, \*California.  
Identifiers: Visalia(CA), Tulare County(CA), Lower Kaweah River(CA), \*Sand Creek(CA), \*Cottonwood Creek(CA), Exeter(CA), Woodlake(CA), Farmersville(CA), Standard Project Flood, Intermediate Regional Flood, Friant-Kern Canal.

The Lower Kaweah River system (drainage area 1,300 sq mi) consists of St. Johns River and these creeks: Camerson, Cross, Deep, Mill, Outside, Packwood, Antelope, Cottonwood, Elbow, Mehrten, Sand and Yokohl. Diversions, channel percolation and evaporation completely dissipate stream flow under normal runoff conditions. Only during major floods do flows reach Tulare Lakebed, terminus of flow from the study area in Northwest Tulare County, a highly developed agricultural region with light industrial, commercial development in the vicinities of Visalia, Woodlake, Exeter, and Farmersville. Flooding has resulted from prolonged heavy rainfall in November through April, snowmelt in April through June, and thunderstorms in late spring to early fall. The worst flood since 1862 occurred in December 1955 when 126,000 acres were inundated. Terminus Dam (Lake Kaweah) completed in 1962, has been effective in reducing flood flows and flood damage (estimated damage preventions -

\$37,000,000). An Intermediate Regional Flood will have a peak discharge of 25,000 cubic feet per second on Lower Kaweah River near McKays Point, channel velocities of 5-14 ft/sec and overbank velocities of 2-6 ft. Critical stage will be about 65 hrs. The Standard Project Flood will have a peak discharge of 39,000 cfs, a critical stage of 73 hrs and will subject the entire study area to flood waters. Obstructions to flow include vegetation, floatable materials, bridges and culverts, and the Friant-Kern Canal where small siphon structures cannot carry flood flows, causing inundation of adjacent areas. Tulare County has a Flood Plain Zoning Ordinance which has not been implemented. (Henley-North Carolina)  
W77-04216

**SPECIAL FLOOD HAZARD INFORMATION REPORT: BETZ ROAD DITCH, CITY OF BELLEVUE, NEBRASKA.**

Army Engineer District, Omaha, Nebr.  
Prepared for City of Bellevue, Nebraska, and the State of Nebraska, June 1972. 11 p, 2 fig, 2 plates, 2 tab.

Descriptors: \*Floods, \*Flood plains, \*Flood profiles, \*Nebraska, Flash flood, Overflow, Streamflow forecasting, Flood data, Peak discharge, Flood peak.

Identifiers: Bellevue(NB), Betz Road Ditch(NB), Standard Project Flood, Intermediate Regional Flood, Papillion Creek(NB).

Betz Road Ditch, which drains 1.8 sq mi in northwest Bellevue, NB, is a left bank tributary of Papillion Creek. The channel slopes at 49 ft/mi and varies from 20 ft wide and 6 ft deep near the upstream limits to 80 ft wide and 19 ft deep at the downstream limit. The channel banks have been raised above the floodplain level in some locations by excavation material from the ditch. There is some residential and commercial development in the floodplain, but much of the floodplain is undeveloped agricultural land or pasture. Flooding in the past has been caused by heavy local storms which produce flash floods, and urbanization has increased this threat because of the increase in impervious surfaces. Floods in 1967 and 1971 did some damage to automobiles, roads, and at least one person was drowned. In the event of an Intermediate Regional Flood and Standard Project Flood, peak discharges of 2680 and 6100 cubic ft/sec are predicted, respectively. According to the map with this report, some built-up area would be subject to flooding in these large floods. Also, some bridges and culverts would be obstructive to flow. (Smith-NC)  
W77-04217

**SPECIAL FLOOD HAZARD INFORMATION REPORT: NORTH FORK BIG NEMAHIA RIVER AND TOWN BRANCH, TECUMSEH, NEBRASKA.**

Army Engineer District, Kansas City, Kans.  
Prepared for City of Tecumseh, NB., June 1972. 11 p, 4 fig, 3 plates.

Descriptors: \*Floods, \*Streamflow forecasting, \*Flood plains, \*Nebraska, Maximum probable flood, Flood profiles, Flood data, Peak discharge, Flood peak, Channel improvement.

Identifiers: \*North Fork Big Nemaha River(NB), \*Town Branch(NB), Tecumseh(NB), Standard Project Flood, Intermediate Regional Flood.

The North Fork Big Nemaha River drains about 325 sq mi above Tecumseh, NB. The river, which slopes at 4 ft/mi through the city, has a flood plain which is about 3/4 mile wide. Town Branch, a tributary, drains about 5.3 sq mi and also flows through the city. Many floods have been recorded since 1853, the largest occurring in 1941 when floodwaters were reported to have been 8 ft deep. A definite flood hazard still exists since only channel improvements have been made on the North Fork Big Nemaha River. It is estimated that a peak

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4A—Control Of Water On The Surface

discharge on this river would be 64,000 cubic ft/sec (cfs) in an Intermediate Regional Flood and 118,000 cfs in a Standard Project Flood, while discharges on Town Branch would be 4,200 cfs and 6,870 cfs, respectively, in the two floods. Water velocities would average 1.5 to 3 ft/sec in an Intermediate Regional Flood and 2 to 3.5 ft/sec in a Standard Project Flood. Future floods would reach levels higher than any previously experienced in business and residential areas. (Smith-NC)  
W77-04218

**SPECIAL FLOOD HAZARD INFORMATION REPORT: SOUTH BRANCH WEST FORK BIG BLUE RIVER, HASTINGS, NEBRASKA.**  
Army Engineer District, Kansas City, Kans.  
Prepared for the City of Hastings and Adams County, N.B., March 1973. 16 p, 2 fig, 4 plates.

Descriptors: \*Nebraska, \*Floods, \*Erosion, \*Historic floods, \*Flood plains, Regional flood, Streamflow forecasting, Maximum probable flood, Flood profiles, Peak discharge.  
Identifiers: Standard Project Flood, Intermediate Regional Flood, Hastings(NB), \*South Branch West Fork Big Blue River(NB), \*West Fork Big Blue River(NB), Lake Heartwell(NB).

Originating about 4 miles northwest of the city of Hastings, the South Branch West Fork Big Blue River flows southeast and easterly through Lake Hastings directly north of the city, then eastward to its confluence with West Fork Big Blue River. The flood plain averages 800 ft in width and the streambed slopes at an average of 8 ft per mile. Flooding in Hastings has occurred frequently but only minor damages have occurred due to lack of concentrated flood plain development. However, development has encroached more and more on flood plains and flooding is becoming more of a problem. During an Intermediate Regional Flood (IRF) peak discharges of 6,300 cubic ft/sec and 2,500 cfs are predicted for West Fork Big Blue River and South Branch West Fork Big Blue River, respectively. During a Standard Project Flood (SPF) peak discharges of 19,000 cfs and 7,600 cfs are anticipated on the two streams, respectively. Water velocities during the smaller event would average 5 to 8 ft/sec, while in the larger flood velocities of 8 to 12 ft/sec can be expected. During both of these events the earth filled Lake Hastings dam would be overtopped. This could cause erosion which could lead to failure of the structure and hazardous conditions downstream from it. A large map with a contour interval of 5 ft shows portions of the study area which will be affected by the IRF and SPF. (Smith-NC)  
W77-04219

**SPECIAL FLOOD HAZARD INFORMATION REPORT: REPUBLICAN RIVER AND CROOKED CREEK, RED CLOUD, NEBRASKA.**  
Army Engineer District, Kansas City, Kans.  
Prepared for The City of Red Cloud, Nebraska, October 1971. 20 p, 4 fig, 4 plates.

Descriptors: \*Nebraska, \*Floods, \*Overland flow, \*Flood profiles, \*Historic floods, \*Flood plains, Streamflow forecasting, Peak discharge, Flood peak, Reservoirs.  
Identifiers: Standard Project Flood, Intermediate Regional Flood, \*Republican River(NB), \*Crooked Creek(NB), Red Cloud(NB).

Built-up areas of Red Cloud, Nebraska are subject to flooding from Crooked Creek, with a drainage area of about 30 sq mi, and Republican River which drains almost 25,000 sq mi, with about 22,000 sq mi above Red Cloud. Flood plains range from an average of 800 ft wide for Crooked Creek and 10,000 ft wide for Republican River. The Republican River has flooded Red Cloud many times, the largest flood being in 1935 prior to the completion of Harlan County Lake in 1952 some

49 miles upstream. Damage was not extensive in that event because of the absence of concentrated development and ample warning time. Six Bureau of Reclamation reservoirs provide backup storage for Harlan County Lake. In an Intermediate Regional Flood (IRF) peak discharges of 6,000 cubic feet per second (cfs) and 30,000 cfs are predicted for Crooked Creek and Republican River, respectively. During a Standard Project Flood (SPF) discharges of 15,100 cfs and 43,000 cfs are predicted, respectively. Large sections of land would be covered by sheet flow averaging 1-2 feet deep for the IRF, 2-3 feet deep for the SPF. Some bridges in the area would be obstructive to flow. During the IRF velocities of waters would be 2 to 5 ft/sec and during the SPF velocities would be 4 to 8 ft/sec. (Smith-NC)  
W77-04220

**WATER RESOURCES OF SOUTH-CENTRAL MISSOURI,**  
Geological Survey, Rolla, Mo. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04223

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 2, SUSQUEHANNA AND POTOMAC RIVER BASINS.**  
Geological Survey, Harrisburg, Pa. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04228

**WATER RESOURCES OF THE BIG FORK RIVER WATERSHED, NORTH-CENTRAL MINNESOTA,**  
Geological Survey, Grand Rapids, Minn. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04233

**WATER RESOURCES OF THE BIGHORN BASIN, NORTHWESTERN WYOMING,**  
Geological Survey, Cheyenne, Wyo. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04235

**TIME OF TRAVEL OF SOLUTES IN MISSISSIPPI RIVER FROM THE ARKANSAS-LOUISIANA STATE LINE TO PLAQUEMINES, LOUISIANA,**  
Geological Survey, Baton Rouge, La. Water Resources Div.  
For primary bibliographic entry see Field 5B.  
W77-04241

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 1, DELAWARE RIVER BASIN.**  
Geological Survey, Harrisburg, Pa. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04242

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 3, OHIO RIVER AND ST. LAWRENCE RIVER BASINS.**  
Geological Survey, Harrisburg, Pa. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04243

**FLOOD STUDIES REPORT.**  
For primary bibliographic entry see Field 2A.  
W77-04244

**ARIZONA LAND USE EXPERIMENT,**  
Arizona Resources Information System, Phoenix.

For primary bibliographic entry see Field 7B.  
W77-04245

**THE BIG THOMPSON FLOOD OF 1976 IN COLORADO,**  
Geophysical R and D Corp., Fort Collins, Colo.  
For primary bibliographic entry see Field 2E.  
W77-04247

**PREDICTING RUNOFF INITIATION TIMES UNDER FIELD CONDITIONS IN TROPICAL (HAWAII) SOILS,**  
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.  
For primary bibliographic entry see Field 2G.  
W77-04252

**MANNING'S ROUGHNESS FOR ARTIFICIAL GRASSES,**  
Ecole Polytechnique Federale de Lausanne (Switzerland). Laboratoire d'Hydraulique. W. H. Graf, and V. H. Chhun.  
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 102, No. IR4, Proceedings Paper 12603, p 413-423, December 1976. 8 fig, 2 tab, 9 ref, 2 append.

Descriptors: \*Grasses, \*Channels, \*Roughness(Hydraulic), Roughness coefficient, Reynolds number, Hydraulic properties, Hydraulics, Laboratory tests, Testing, Equations.  
Identifiers: \*Artificial grasses, Hydraulic laboratories, Manning formula.

Roughness of three types of artificial grass was investigated. Artificial grass consists of a matress that simulates the soil surface where groups of grass are fixed in longitudinal and radial rows. The experiments were conducted in rectangular and triangular laboratory flumes. The following conclusions can be drawn: The n-value was found to be dependent on the flow depth and on the Reynolds number at low range of depths. The n-value was shown to be independent of the flow parameters at a high range of depths. The constant roughness coefficient values for the higher discharges were  $n = 0.032$ ,  $n = 0.027$ , and  $n = 0.020$  for the different artificial grasses. These n-values are in good agreement with the experimental results for 'real' grass found in the literature. It may be concluded, therefore, that artificial grass will be a useful material when simulating grass in the hydraulic laboratory. (Lee-ISWS)  
W77-04255

**ESTIMATION OF THE PARAMETERS OF CATASTROPHIC MUDFLOWS IN THE BASINS OF THE LESSER AND GREATER ALMATINKA RIVERS,**  
For primary bibliographic entry see Field 2J.  
W77-04257

**EFFECT OF INDUSTRIAL ACTIVITY ON RIVER RUNOFF IN THE CENTRAL URAL,**  
For primary bibliographic entry see Field 4C.  
W77-04258

**MORPHOMETRY AND FLOODS IN SMALL DRAINAGE BASINS SUBJECT TO DIVERSE HYDROGEOMORPHIC CONTROLS,**  
Texas Univ., Austin. Dept. of Geological Sciences.  
For primary bibliographic entry see Field 2E.  
W77-04265

**SEDIMENT YIELD-RUNOFF-DRAINAGE AREA RELATIONSHIPS IN THE UNITED STATES,**  
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.  
For primary bibliographic entry see Field 2J.  
W77-04272

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## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Control Of Water On The Surface—Group 4A

**SINEPOWER PROBABILITY DENSITY FUNCTION,**  
Institute of Hydraulics and Hydrology, Poondi  
(India).  
For primary bibliographic entry see Field 2E.  
W77-04276

**INVESTIGATION INTO METHODS FOR DEVELOPING A PHYSICAL ANALYSIS FOR EVALUATING INSTREAM FLOW NEEDS,**  
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.  
For primary bibliographic entry see Field 2E.  
W77-04296

**DESALINATION OF SOILS OF MENOFAYA GOVERNORATE PUT UNDER TILE DRAINAGE,**  
Ain Shams Univ., Cairo (Egypt). Dept. of Soils, and Ain Shams Univ., Cairo (Egypt). Faculty of Agriculture.  
For primary bibliographic entry see Field 2G.  
W77-04322

**LEACHING OF SALINE SOILS IN MONOLITHS OF IRAQ,**  
Cairo Univ., Giza (Egypt). Dept. of Soils.  
For primary bibliographic entry see Field 2G.  
W77-04324

**RIGHTS OF IMPORTERS AND DEVELOPERS OF WATER: DENVER V FULTON IRRIGATING DITCH COMPANY,**  
For primary bibliographic entry see Field 6E.  
W77-04348

**THE DEGREE OF EFFECTIVENESS OF INTERNATIONAL LAW AS REGARDS INTERNATIONAL RIVERS,**  
Egyptian Embassy, Hague (Netherlands).  
For primary bibliographic entry see Field 6E.  
W77-04354

**THE FLOOD PLAIN ZONING EXPERIENCE IN THE GREAT LAKE STATES,**  
Florida Univ., Gainesville. School of Law.  
For primary bibliographic entry see Field 6E.  
W77-04364

**GARRISON DIVERSION UNIT IRRIGATION PROJECT: PROSPECTS AND PROBLEMS, PART 2.**  
For primary bibliographic entry see Field 6E.  
W77-04365

**MARSHALL FORD DAM AND RESERVOIR, COLORADO RIVER, TEXAS; REVISION OF FLOOD CONTROL REGULATIONS.**  
Department of Defense, Washington, D.C.  
For primary bibliographic entry see Field 6E.  
W77-04369

**FLOOD CONTROL REGULATIONS.**  
Corps of Engineers, Washington, D.C.  
Federal Register, Vol 41, No 97, p 20400-06 (May 18, 1976). 7 p, 6 tab.

Descriptors: \*Flood control, \*Regulation, \*Reservoir storage, \*Water management(Applied), \*Administrative agencies, Federal government, Dams, Reservoirs, Navigation, Lakes, Runoff, Data collections, Project planning, Instrumentation, Reservoir releases, Safety, Multiple-purpose reservoirs, Reservoir operation, Structures, Hydrologic data, River forecasting, Meteorological data.  
Identifiers: \*Administrative regulations, \*FWPCA Amendments of 1972.

The Corps of Engineers has promulgated regulations prescribing the policy and procedures governing the use of storage allocated for flood control or navigation at all reservoirs constructed with federal funds. These regulations are not applicable to projects owned and operated by the Corps of Engineers, the International Boundary and Water Commission, the United States and Mexico, or those under the jurisdiction of the Columbia River treaty. A summary of comments on the regulations from interested parties is included and procedures are specified for project owners for all phases of the project. The Corps of Engineers retains the authority to prescribe regulation of flood control or navigation storage space on an emergency basis without the request of the project owner. Requirements are specified for the water control plan and manual, the water control agreement, hydrometeorological instrumentation, and project safety. Tables of pertinent project data are included for the projects subject to the regulations and contain the following information: project name, stream, county and state, storage space to be reserved in both exclusive and multiple-purpose projects, the project owner, and the authorizing legislation. (Capehart-Florida)  
W77-04371

**FACTORS AFFECTING FOREST PRODUCTION ON ORGANIC SOILS,**  
North Carolina State Univ., Raleigh. Dept. of Forestry.  
T. E. Maki.

In: Histosols: Their Characteristics, Use, and Classification, Ch. 10, p. 119-136, 1974. 5 tab, 15 ref. OWRT B-094-NC(2), 14-34-0001-6107.

Descriptors: \*Forests, \*Organic soils, \*Productivity, \*Drainage, \*Forest management, Water table, Soil physical properties, North Carolina, Bogs.  
Identifiers: Pocosins, \*Pocosin ecosystems.

In major wood-producing countries throughout the world, organic soils occupy extensive areas within the 4 billion ha classed as predominantly forest land. With continuing decrease in land available for wood production, foresters have intensified their exploration of the possibilities of forest management on organic soils which in the existing 'undisturbed' state are generally submarginal for growing usable wood on an economic scale. The pocosin or raised bogs of eastern North Carolina fall into this submarginal category, and the 31.6-thousand-ha Hofmann Forest in Jones and Onslow counties is representative of soil, vegetation, and hydrologic characteristics, as well as of forest management problems of pocosin ecosystems. Experience encountered in tests of forest management practices on organic soils and results of some research on the Hofmann Forest are described. Special emphasis is given to drainage, water table behavior, pocosin vegetation, soil properties, and growth of pines in response to site preparation and amelioration. Changes in the pocosin environment as a result of forest management practices are postulated. (Stewart-NC State)  
W77-04387

**A SENSIBLE ALTERNATIVE TO STREAM CHANNELIZATION,**  
North Carolina Univ. at Charlotte. Dept. of Geography and Earth Science.

E. A. Keller, and E. K. Hoffman.  
Public Works, Oct. 1976, 3 p. OWRT B-089-NC(2), 14-34-0001-6103.

Descriptors: \*Channel morphology, \*Channel improvement, \*Geomorphology, Drainage engineering, Bank stability, Stream improvement, Stream stabilization, Channel erosion, \*North Carolina.

Identifiers: \*Channel restoration, \*Fluvial process, Fluvial geomorphology, Stream alignment, Channelization, Mecklenburg County(NC), Charlotte(NC).

In Mecklenburg County, North Carolina a program of stream restoration is being used as an alternative to traditional stream channelization. Stream restoration is the process of altering urban stream channels so their behavior is similar to natural streams, while providing some measure of flood prevention or control and producing a positive esthetic experience. Stream channel restoration on urban streams involves removal of urban trash, extensive growth of small trees and brush, and removal of large trees that have fallen into the stream channel. It involves neither straightening or enlarging the bottom of the stream channel nor removal of all trees along the banks. To the contrary, as many trees as possible are left. The root systems of established trees help to control erosion and increase the esthetic quality of the stream bank environment. On stream bends, the inside of the bend is sloped to a three to one (or less) angle. This facilitates the development of a sandbar on the inside of the bend as is found in natural stream channels. The outside of bends may be riprapped where absolute bank stability is required. In most cases, however, the stream bank is sloped and planted in grass for stabilization. (Stewart-NC State)  
W77-04388

**SILVICULTURAL ASPECTS OF FOREST DRAINAGE,**  
North Carolina State Univ., Raleigh. Dept. of Forestry.

T. E. Maki.  
Paper presented at International Symposium on forest Drainage, Finland, Sept. 2-6, 1974. 27 p, 2 tab, 27 ref. OWRT B-094-NC(1), 14-34-0001-6107.

Descriptors: Forests, \*Productivity, \*Soil moisture, \*Organic soils, Water table, Fertilization, Hydrologic systems, \*Drainage, \*Forest management, Conifers, Forest soils, Coniferous forests, Land development.  
Identifiers: \*Forest drainage.

When one adds the loss of forest land from developments to that being cleared for the needed increases in food production and that which is being set aside for open space and wilderness, it is easy to see why future wood requirements must be produced not only from a smaller land base, but also from soils that are likely to average lower than heretofore in native potential for the production of wood. Within the past quarter century, these developments and circumstances have provided the impetus to foresters for intensifying their efforts toward improving the forest production on those wetlands which have proven sub-marginal for growing trees to any specified size and condition of merchantability. Drainage of these lands has been considered as the first essential step to establish or restore viable forest production on them. Those wetlands comprised mainly of organic soils are discussed. Only silvicultural aspects relating to coniferous species were considered. (Stewart-NC State)  
W77-04390

**MIDDLE FORK BAYOU D'ARBONNE RESERVOIR PROJECT, CLAIBORNE PARISH, LOUISIANA: A FEASIBILITY AND SOCIAL IMPACT STUDY,**  
Louisiana State Univ., Baton Rouge. Center for Agricultural Sciences and Rural Development.

For primary bibliographic entry see Field 6B.  
W77-04562

**AQUATIC PLANTS: A GUIDE FOR THEIR IDENTIFICATION AND CONTROL IN PENNSYLVANIA,**  
Pennsylvania - Water Resources Coordinating Committee, Harrisburg.  
For primary bibliographic entry see Field 5G.  
W77-04570

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4A—Control Of Water On The Surface

**RESPONSE OF AEROBIC COMMUNITY METABOLISM TO CHEMICAL TREATMENT OF AQUATIC MACROPHYTES,** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.  
For primary bibliographic entry see Field 5C.  
W77-04576

### 4B. Groundwater Management

**APPLICATION OF ENVIRONMENTAL TRITIUM IN THE MEASUREMENT OF RECHARGE AND AQUIFER PARAMETERS IN A SEMI-ARID LIMESTONE TERRAIN,** New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.  
For primary bibliographic entry see Field 2F.  
W77-04106

**NEW MEXICO WATER RESOURCES, ASSESSMENT FOR PLANNING PURPOSES.** Bureau of Reclamation, Amarillo, Tex. S Region 5.  
For primary bibliographic entry see Field 6B.  
W77-04112

**MONITORING GROUNDWATER QUALITY: ECONOMIC FRAMEWORK AND PRINCIPLES,** General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.  
For primary bibliographic entry see Field 5A.  
W77-04113

**WELL LOGGING MANUAL.** Scientific Software Corp., Denver, Colo.  
For primary bibliographic entry see Field 8G.  
W77-04115

**LEACHATE DAMAGE ASSESSMENT, CASE STUDY OF THE PEOPLES AVENUE SOLID WASTE DISPOSAL SITE IN ROCKFORD, ILLINOIS,** Environmental Protection Agency, Cincinnati, Ohio. Office of Solid Waste Management Programs.  
For primary bibliographic entry see Field 5B.  
W77-04122

**THE BACTERIOLOGICAL EXAMINATION OF GROUNDWATER SOURCES IN BETUL DISTRICT, MADHYA PRADESH, INDIA,** E.L.C. Water Development Project, Betul (India).  
For primary bibliographic entry see Field 5B.  
W77-04123

**GROUND WATER RESOURCES OF THE BEDROCK AQUIFERS OF THE DENVER BASIN COLORADO,** Colorado Dept. of Natural Resources, Denver. Div. of Water Resources, Planning and Investigations.  
For primary bibliographic entry see Field 2F.  
W77-04126

**A NOTE ON AN IN SITU GROUNDWATER SAMPLING PROCEDURE,** Nebraska Univ., Lincoln. Div. of Natural Resources, Conservation and Survey.  
For primary bibliographic entry see Field 5A.  
W77-04127

**THE IMPACT OF INTENSIVE APPLICATION OF PESTICIDES AND FERTILIZERS ON UNDERGROUND WATER RECHARGE AREAS WHICH MAY CONTRIBUTE TO DRINKING**

**WATER SUPPLIES. A PRELIMINARY REVIEW,** Environmental Protection Agency, Washington, D.C. Office of Toxic Substances.  
For primary bibliographic entry see Field 5B.  
W77-04128

**EVALUATING WELL CONSTRUCTION,** Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.  
For primary bibliographic entry see Field 8B.  
W77-04131

**WELL CONSTRUCTION AND WATER QUALITY,** Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.  
For primary bibliographic entry see Field 5G.  
W77-04132

**USING UNCONFORMITIES TO LOCATE WELLS,** National Water Well Association, Worthington, Ohio.  
For primary bibliographic entry see Field 8E.  
W77-04133

**GENERATION OF LEACHATE FROM LANDFILLS AND ITS SUBSURFACE MOVEMENT,** Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management.  
For primary bibliographic entry see Field 5B.  
W77-04134

**SYSTEM PREVENTS LEACHATE FORMATION.** For primary bibliographic entry see Field 5G.  
W77-04136

**SUMMARY OF SELECTED COURT CASE IN WATER CONSERVATION AND GROUNDWATER LITIGATION,** Arizona Univ., Tucson.  
For primary bibliographic entry see Field 6E.  
W77-04139

**HYDROGEOLOGIC STUDY, NEW HORIZONS SUBDIVISION, CARROLL COUNTY, MARYLAND,** Maryland Dept. of Natural Resources, Annapolis. Water Resources Administration.  
C. A. Wheeler, J. W. Vukovich, and J. O. Neighbours.  
Maryland Water Resource Investigation, Water Permits Section, May 18, 1976. p 23, 9 fig, 2 append.

Descriptors: \*Water wells, \*Water pollution, \*Septic tanks, \*Groundwater, \*Fractures(Geology), On-site investigations, Wastewater treatment, Water distribution(Applied), \*Maryland.  
Identifiers: \*Groundwater movement, Septic tank pollution, Failing septic tank systems, New Horizons Subdivision, Carroll County(Maryland).

The hydrogeologic study at the New Horizons subdivisions was designed to provide information concerning the contamination of individual water wells. This necessitated an investigation of the physical environment and its interrelationship with the wells and wastewater disposal systems. The results of the study demonstrated: (1) The movement of groundwater in the area is complex and controlled largely by fractures and erosional features of the underlying rock. Because of this wastewater from septic systems is able to move easily toward wells with little chance for attenuation of contaminants. (2) There is an unresolved question with respect to the effectiveness of the

length of casing used to construct many of the wells. (3) Failing septic systems, in conjunction with relatively small lot sizes are the primary cause of the degradation of ground water quality. Alternatives for the solution of the problem in order of desirability are: (1) The use of individual wastewater disposal systems should be discontinued and replaced by a centralized wastewater treatment facility. (2) Proceed with the construction of a central water distribution system. (3) Replace existing contaminated wells with wells which utilize substantially longer casings. (Heiss NWWA)  
W77-04140

**ROLE OF THE HEAT STORAGE WELL IN FUTURE U.S. ENERGY SYSTEMS,** General Electric TEMPO, Santa Barbara, California, Center for Advanced Studies.  
C. F. Meyer, W. Hausz, B. L. Ayres, and H. M. Ingram.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 480. Price codes: A09 in paper copy, A01 in microfiche. Final Technical Completion Report GE76TMP-27 December 1976. 175 p, 27 fig, 15 tab, 117 ref. OWRT C-5205(4210)(5) and C-6265(5223)(2).

Descriptors: \*Thermal powerplants, \*Underground storage, \*Heat transmission, \*Heating, \*Pollution abatement, Fuels, Energy, Energy loss, Energy conversion, Energy budget, Heat flow, Heated water, Pipelines, Wells, Injection wells, Water storage, Groundwater movement, Flow profiles, Environmental control, Air pollution, Thermal pollution, Waste heat, Cooling water, Electric power plants, Electric power industry, Utilities, Public utilities, Institutional constraints, Financing, Costs, Joint costs, Cost comparisons, Economic feasibility.  
Identifiers: \*Thermal energy storage, \*Energy conservation, Uses of heat.

The Heat Storage Well system concept is found to have the potential to decrease U.S. energy consumption 10 to 15 percent while substantially reducing water and air pollution. Energy to be conserved is principally that now wasted in generating electricity and in burning fossil fuels for space heating. Results of a study of technical, economic, institutional, environmental, and legal aspects of implementation are reported. Joint production of power and heat with gas turbines and at large central coal-fired plants is analyzed. Costs of joint production, with heat storage, are compared to separate costs of generating heat on-site and purchasing electricity. Water heated as electricity is generated is injected via Heat Storage Wells into aquifers where it is stored to be withdrawn as needed to meet seasonal heat loads. About 75-percent heat recovery is expected. Producing heat and power jointly with a gas turbine and heat-recovery system with heat storage is compared to separate product systems and found to cost 25 percent less and to consume 35 percent less fuel. Electricity and heat can be produced jointly and transmitted as far as 125 miles (200 km) from a central plant at a cost about equal to separate-product costs, with an energy saving of 16 percent. Regulatory institutions governing utilities do not yet regard energy conservation as an important consideration but practices are changing. Municipal utilities, close to community desires such as converting from oil and gas to coal, and with ability to finance more easily than investor-owned utilities by bonds and taxation, are most likely to first implement the Heat Storage Well system concept.  
W77-04145

**GROUND-WATER RESOURCES OF THE WHITE RIVER JUNCTION AREA, VERMONT,** Geological Survey, Montpelier, Vt. Water Resources Div.  
A. L. Hodges, Jr. D. Butterfield, and J. W. Ashley. Vermont Agency of Environmental Conservation, Montpelier, Department of Water Resources, 1976. 27 p, 11 fig, 3 plates, 3 tab, 5 ref.

Descriptors: \*Groundwater resources, \*Test wells, \*Water supply, \*Aquifer characteristics, \*Vermont, Observation wells, Pumping, Water yield, Water quality, Groundwater recharge, Hydrogeology, Transmissivity, Specific capacity, Planning, Well data.  
Identifiers: Windsor County(VT).

A study of the groundwater resources of the White River Junction area, Windsor County, Vermont, was begun in 1969 to provide technical appraisal of potential sources of water to meet the expanded needs of towns in the county. Test work was carried out in 3 phases. The first was seismic refraction profiling at several locations to determine the shape, thickness, location, and type of materials below the surface of the land. The second phase was subsurface sampling with auger and wash borings to determine the permeability of the subsurface materials. Observation wells, 1 1/4 inches in diameter, were installed in auger or wash-bore holes at four locations that were found to have potential for development as municipal water supplies. These small-diameter wells served as observation wells during the third phase of the program, during which an 8-inch well was constructed at each of the four locations and the aquifer tested. The 4 test wells, finished with wire-wrapped screen, were pumped until the pumped water was virtually sand-free, assuring good well efficiency during testing. After the wells were developed, 3 of the wells were pumped for 48 hours, and drawdown and recovery were measured in the pumping well and at least one observation well. Aquifer test data are described for 11 sites. (Woodard-USGS)  
W77-04221

#### GROUND-WATER RESOURCES OF THE BARRE-MONTPELIER AREA, VERMONT, 1976

Geological Survey, Montpelier, Vt. Water Resources Div.

A. L. Hodges, Jr., D. Butterfield, and J. W.

Ashley.

Vermont Agency of Environmental Conservation, Montpelier, Department of Water Resources, 1976. 27 p, 7 fig, 3 plates, 2 tab, 9 ref.

Descriptors: \*Groundwater resources, \*Aquifer characteristics, \*Hydrogeology, \*Water quality, \*Vermont, Available water, Water levels, Water wells, Pumping, Water yield, Geologic mapping.  
Identifiers: \*Barre-Montpelier area(VT).

Ground water in the Barre-Montpelier area, Vermont, occurs in bedrock, and in overlying unconsolidated deposits of glacial origin. The bedrock is composed of a series of shallow to steeply dipping metamorphic rocks. Average yield of wells in the various bedrock formations ranges from 11 to 19 gpm (gallons per minute), and average depth ranges from 147 to 221 feet. Fracture zones (lineaments) in bedrock were mapped in detail to determine the relationship of these lineaments to well yield. Two wells adjacent to lineaments had yields of 60 and 90 gpm, whereas a nearby well in the same bedrock formation, but not adjacent to a lineament yielded only 10 gpm. Unconsolidated deposits in the Barre-Montpelier area include unsorted glacial till, and water-sorted clay, silt, sand, and gravel. Properly constructed wells in the unconsolidated materials have an average yield of 87 gpm, and an average depth of 53 feet. Chemical constituents of ground water in the Barre-Montpelier area reflect the composition of underlying bedrock. Wells in areas of carbonate bedrock are generally higher in pH, hardness, and dissolved solids than those that obtain water from siliceous, or slate bedrock. Iron and manganese concentrations that approach or exceed State health regulations were found at one area in the northeastern part of the project area. (Woodard-USGS)  
W77-04222

#### WATER RESOURCES OF SOUTH-CENTRAL MISSOURI, 1976

Geological Survey, Rolla, Mo. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04223

#### BASEMENT FLOODING AND FOUNDATION DAMAGE FROM WATER-TABLE RISE IN THE EAST NEW YORK SECTION OF BROOKLYN, LONG ISLAND, NEW YORK, 1975

Geological Survey, Mineola, N.Y. Water Resources Div.

J. Soren.

Available from the National Technical Information Service, Springfield VA 22161 as PB-261 190, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Investigations 76-95, October 1976. 14 p, 9 fig, 6 ref.

Descriptors: \*Groundwater, Flooding, \*Water level fluctuations, \*Damages, \*Buildings, Foundations, \*New York, Dewatering.

Identifiers: \*Brooklyn(NY), \*Long Island(NY), Water-table rise.

A rising water table following cessation of public-supply pumping has been causing basement flooding and building-foundation damage in the East New York section of Brooklyn, Kings County, Long Island, N.Y., since 1975. The water table in the central part of the area rose from a low of about 12 feet (3.7 meters) below sea level in 1936 to about 8 to 10 feet (2.4 to 3 meters) above sea level in March 1976. Public-supply pumping in Brooklyn ceased in 1947 and ceased in 1974 in the adjacent Woodhaven section of Queens County. A further water-table rise of about 2 feet (0.6 meter) is anticipated in the next several years in the central part of the East New York area, and the ultimate water-table height could be as much as about 15 feet (4.6 meters) above sea level. Relief from the flooding by dewatering operations is complicated by problems with disposal of pumped-out ground water. (Woodard-USGS)  
W77-04227

#### WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 2. SUSQUEHANNA AND POTOMAC RIVER BASINS

Geological Survey, Harrisburg, Pa. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04228

#### WATER RESOURCES OF THE BIG FORK RIVER WATERSHED, NORTH-CENTRAL MINNESOTA, 1975

Geological Survey, Grand Rapids, Minn. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04233

#### GEOHYDROLOGIC MAPS OF THE POTOMAC-RARITAN-MAGOOTHY AQUIFER SYSTEM IN THE NEW JERSEY COASTAL PLAIN, 1975

Geological Survey, Trenton, N. J. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04234

#### WATER RESOURCES OF THE BIGHORN BASIN, NORTHWESTERN WYOMING, 1975

Geological Survey, Cheyenne, Wyo. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04235

#### MAP SHOWING GROUND-WATER CONDITIONS IN THE ARAVIA VALLEY AREA, GRAHAM AND PINAL COUNTIES, ARIZONA—1975

Geological Survey, Tucson, Ariz. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04236

#### GEOLOGY AND GROUND-WATER RESOURCES OF NORTHERN MERCER COUNTY, PENNSYLVANIA, 1975

Geological Survey, Harrisburg, Pa. Water Resources Div.

For primary bibliographic entry see Field 2F.  
W77-04239

#### WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 1. DELAWARE RIVER BASIN

Geological Survey, Harrisburg, Pa. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04242

#### WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 3. OHIO RIVER AND ST. LAWRENCE RIVER BASINS

Geological Survey, Harrisburg, Pa. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04243

#### PROSPECTS FOR USING GROUND WATER IN THE KAZAKH SSR, 1975

V. M. Belyakov, and V. A. Perevedentsev.

Soviet Hydrology, Selected Papers, No. 2, p 101-105, November 1975. 5 tab. Translated from Gidrotekhnika i Melioratsiya, No. 3, p 100-107, 1975.

Descriptors: \*Groundwater, \*Surveys, \*Groundwater availability, Aquifers, Wells, Arid lands, Deserts, Foreign countries, Irrigation, Foreign research, Agriculture, Artesian wells, Water wells, Groundwater basins, Water supply, Geology, Subsurface waters, Water yield, Water sources.  
Identifiers: \*USSR, \*Kazakh SSR, \*Kazakhstan.

The Kazakh SSR lies within the arid and semi-arid zones and has, therefore, a severe moisture deficit. Because of the great differences in elevations in individual parts of this territory, climatic and landscape conditions are very diversified. Parts of the Turan, Caspian, and West Siberian lowlands extend into Kazakhstan in the north and west, and the outliers of the Altay, Dzhungarian Ala-Tau, and of the North and Central Tien-Shan penetrate into the south and east of the region. Surface waters are confined in Kazakhstan either to large plains (Irtysh, Syr-Dar'ya, Ural, Ili rivers) or to piedmont rivers. However, surface waters are seasonal over most of the region, represented by sand and clay deserts. Under these conditions, groundwaters serve as sources of water supply to populated areas and to agricultural areas for irrigation. The groundwater resources of the republic have been explored on a large scale and computed; their main basins have been determined; their patterns of formation and distribution have been established; their chemical composition studied; etc. Considerable experience has been acquired in groundwater utilization. It was concluded that the Kazakh SSR has large reserves of groundwater which can be used for agricultural purposes. Of particular interest for irrigation are waters with a low mineral content. Further groundwater utilization poses several serious problems to the scientific research and industrial organizations of the republic. It is first necessary to explore in detail and to estimate the groundwater resources for irrigating large areas in desert regions, to develop and introduce techniques for constructing high-yield wells, to solve technical-economic problems of groundwater utilization for irrigation, and to develop recommendations for the use of waters with a low mineral content in various zones of the republic. (Sims-ISWS)  
W77-04262

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4B—Groundwater Management

#### MODEL-FREE STATISTICAL METHODS FOR WATER TABLE PREDICTION, Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.

S. Yakowitz.

Water Resources Research, Vol. 12, No. 5, p 836-844, October 1976. 14 fig, 20 ref. NSF GK-35915, GF-38183.

Descriptors: \*Water table, \*Statistical models, \*Depth, \*Well data, \*Arizona, Water wells, Time series analysis, Stochastic processes, Statistical methods, Homogeneity, Forecasting, Equations, Regression analysis, Water levels, Aquifer characteristics.

Identifiers: \*Tucson Basin, \*Cluster analysis, \*Subregions, Confidence bands.

In this study a new approach for predicting future values of well depths on the basis of regional water table records was presented. Basically, well water level depths are viewed as random sequences, and the assumption is made that the region to be analyzed can be partitioned into several subregions of unknown geographic shapes which are statistically homogeneous in the sense that the record of each well in a fixed subregion is a different realization of the same stochastic process. Methods from clustering and time series analysis were used to find (1) the subregions of stochastic homogeneity, and (2) the statistical law for the time series of the wells in a given subregion. Forecasts were made and confidence bands constructed by using the methods espoused here (in conjunction with regression techniques) on Tucson basin data. The forecasts were compared to depths actually observed, and, for many wells, the agreement was sufficient to make these new methods appear promising. (Visocky-ISWS)

W77-04264

#### HYDROLOGY OF SALINE SEEPS IN THE NORTHERN GREAT PLAINS, Agricultural Research Service, Mandan, N. Dak. Northern Great Plains Research Center.

For primary bibliographic entry see Field 5G.

W77-04268

#### LAND SUBSIDENCE COSTS IN THE HOUSTON-BAYTOWN AREA OF TEXAS, Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.

For primary bibliographic entry see Field 2F.

W77-04280

#### IRRIGATION WELL EFFICIENCY, Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources.

For primary bibliographic entry see Field 8B.

W77-04292

#### MAKING WATER AVAILABLE FOR IRRIGATION, Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.

D. M. Manbeck.

In: Proceedings of Irrigation Short Course, January 24-25, 1977, Lincoln, Nebraska, Nebraska Center for Continuing Education, p 117-124, 1 fig, 1 tab.

Descriptors: \*Irrigation, \*Groundwater recharge, \*Artificial recharge, Recharge wells, Recharge pits, Water spreading, Drawdown, Water sources, Model studies, \*Nebraska.

Identifiers: \*Groundwater decline, Energy usage.

Several areas in Nebraska are experiencing a decline in water tables caused by the increasing withdrawal of water for irrigation purposes. This drop in the levels of underground water is the primary reason for considering artificial recharge. Three methods of artificial recharge are considered: (1) Surface application methods which in-

volve the placement of water on the ground in order to increase the amount of water which can infiltrate into the ground and move to the water table; (2) Placement of water into pits or shaft which penetrate permeable at shallow depth; and (3) recharge wells that allow water to move directly from the surface to the underground water bearing formations. Most recharge systems lose their capacity to recharge with time. The decrease in recharge rates are dependent on the type of method used; and the amount of suspended material, bacteria, entrained air and chemical quality of the water being recharged. Three field research projects on artificial recharge of Nebraska's ground water are currently in progress. One project involves studying the amount of water which moves downward beneath the reservoir of flood retarding structure. An associated project is measuring the amount of water infiltrating through the bottom of a stream. The third project is using recharge wells. (Gass-NWWA)

W77-04293

#### GARRISON DIVERSION UNIT IRRIGATION PROJECT: PROSPECTS AND PROBLEMS, PART 2.

For primary bibliographic entry see Field 6E.

W77-04365

#### 4C. Effects On Water Of Man's Non-Water Activities

##### LAND USE PLANNING: IMPORTANT TOOL FOR CONTROLLING WATER DEMANDS, Metcalf and Eddy, Inc., Boston, Mass.

For primary bibliographic entry see Field 6D.

W77-04173

##### TERRESTRIAL CONTRIBUTION OF N TO STREAM WATER IN MANAGED AND UNDISTURBED FORESTED WATERSHEDS, New Mexico State Univ., University Park. Dept. of Biology.

For primary bibliographic entry see Field 5B.

W77-04178

##### STATE OF OREGON COASTAL ZONE MANAGEMENT PROGRAM, DRAFT ENVIRONMENTAL IMPACT STATEMENT, National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management.

For primary bibliographic entry see Field 6G.

W77-04184

##### PROPOSED FEDERAL APPROVAL OF THE COASTAL ZONE MANAGEMENT PROGRAM, MID-COAST SEGMENT, STATE OF MAINE, DRAFT ENVIRONMENTAL IMPACT STATEMENT. National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management.

For primary bibliographic entry see Field 6G.

W77-04185

##### BARATARIA BASIN: GEOLOGIC PROCESSES AND FRAMEWORK, Louisiana State Univ., Baton Rouge. Center for Wetland Resources.

For primary bibliographic entry see Field 2L.

W77-04187

##### AN ANALYSIS OF THE INTERNATIONAL GREAT LAKES LEVELS, BOARD REPORT ON

#### REGULATION OF GREAT LAKES WATER LEVELS. HYDROLOGY, Wisconsin Univ., Madison. Inst. for Environmental Studies.

For primary bibliographic entry see Field 2H.

W77-04191

#### ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. VOLUME 1. PRINCIPAL INVESTIGATORS' REPORTS APRIL-JUNE 1976.

National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

For primary bibliographic entry see Field 6G.

W77-04200

#### ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. VOLUME 2. PRINCIPAL INVESTIGATORS' REPORTS APRIL - JUNE 1976.

National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

For primary bibliographic entry see Field 6G.

W77-04201

#### EFFECT OF INDUSTRIAL ACTIVITY ON RIVER RUNOFF IN THE CENTRAL URAL, N. M. Lalyushinskaya, G. M. Ostrovskiy, and I. S. Shakhev.

Soviet Hydrology, Selected Papers, No. 2, p 81-83, November 1975. 2 tab, 4 ref. Translated from Trudy Gosudarstvennogo Gidrologicheskogo Instituta, No. 221, p 259-265, 1975.

Descriptors: \*Runoff, \*Industrial waters, \*Water resources, Rivers, Foreign countries, Reservoirs, Foreign research, Evaporation, Hydroelectric plants, Industrial plants, Industries, River flow, Streamflow, Water reuse, Water loss, Runoff forecasting.

Identifiers: \*USSR, \*Ural Mountains(USSR).

The rapid development of industry involves increasing utilization of water resources. Accompanying changes in the river regime may occur for the following reasons: (1) changes in the channel systems of rivers (flow regulation by reservoirs, diversion of flow from basin to basin, water withdrawal from channels and inflow of return waters into rivers); (2) changes in the physiographic conditions of river drainage basins (forest felling, drainage and irrigation, plowing, and snow retention in fields, etc.). The first group of activities is most widespread in the Central Ural. Tens of ponds designed for hydraulic power installations and water supply to metallurgical plants and settlements were constructed as early as the middle of the 18th century. Subsequently, because of the development of industry and the growth of cities, the upper reaches of most of the rivers, especially on the east slope of the Ural, were regulated by numerous reservoirs. Hydroelectric power stations were constructed on several medium and large rivers, including the Kama and Volksk reservoirs on the Kama River, Pavlovsk reservoir on the Ufa River, Shirokovskoye reservoir on the Kos'va River, and the upper Tura reservoir on the Tura River. The many existing small, rural hydroelectric power stations on the small rivers of the Ural have now been closed. Because of the regulation of rivers and utilization of their water resources, annual runoff, its intra-annual distribution, and extremes have changed in several river basins. The effect of industrial activity on individual runoff characteristics was investigated. (Sims-ISWS)

W77-04258

#### SOME THERMAL AND BIOLOGICAL EFFECTS OF FOREST CUTTING IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Div. of Forestry.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

For primary bibliographic entry see Field 5C.  
W77-04273

**POTENTIAL IMPACT OF THE DEVELOPMENT OF LIGNITE RESERVES ON WATER RESOURCES OF EAST TEXAS,**  
Texas A and M Univ., College Station. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5B.  
W77-04297

**A SENSIBLE ALTERNATIVE TO STREAM CHANNELIZATION,**

North Carolina Univ. at Charlotte. Dept. of Geography and Earth Science.

For primary bibliographic entry see Field 4A.  
W77-04388

**GRAZING AND DEBRIS BURNING ON PINYON-JUNIPER SITES—SOME CHEMICAL WATER QUALITY IMPLICATIONS,**

Utah Center for Water Resources Research, Logan; and Utah State Univ., Logan. Dept. of Range Service.

For primary bibliographic entry see Field 5B.  
W77-04392

**SEDIMENT PRODUCTION AND INFILTRATION RATES AS AFFECTED BY GRAZING AND DEBRIS BURNING ON CHAINED AND SEEDED PINYON-JUNIPER,**

Utah State Univ., Logan. Dept. of Range Service. J. C. Buckhouse, and G. F. Gifford.

Journal of Range Management, Vol 29, No 1, January 1976, p 83-85. 2 fig, 5 ref. OWRT A-022-Utah(3), 14-34-0001-6046.

Descriptors: \*Sediment yields, \*Infiltration rates, \*Grazing, Debris, \*Pinyon pine trees, \*Juniper trees, \*Burning, \*Utah.

Identifiers: Southeastern Utah.

Sediment production and infiltration rates were measured in conjunction with an analysis of burning and grazing treatments in a chained pinyon-juniper study in southeastern Utah. While high natural variability was present among sites, no significant changes in sediment production were detected following prescribed burning or grazing treatments. Following treatment, however, both the burned and grazed sites exhibited significantly depressed infiltration rates during certain time intervals in comparison to the 'undisturbed, natural' woodland control location.  
W77-04393

**RURAL ROAD SYSTEMS AS A SOURCE OF SEDIMENT POLLUTION - A CASE STUDY,**  
North Carolina State Univ., Raleigh. Dept. of Forestry.

For primary bibliographic entry see Field 5B.  
W77-04394

### 4D. Watershed Protection

**EFFECTS OF AGRICULTURAL PRACTICES AND LAND DISPOSAL OF SOLID WASTE ON QUALITY OF WATER FROM SMALL WATERSHEDS,**  
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 5B.  
W77-04102

**TERRESTRIAL CONTRIBUTION OF N TO STREAM WATER IN MANAGED AND UNDISTURBED FORESTED WATERSHEDS,**  
New Mexico State Univ., University Park. Dept. of Biology.

For primary bibliographic entry see Field 5B.  
W77-04178

**MORPHOMETRY AND FLOODS IN SMALL DRAINAGE BASINS SUBJECT TO DIVERSE HYDROGEOMORPHIC CONTROLS,**  
Texas Univ., Austin. Dept. of Geological Sciences.

For primary bibliographic entry see Field 2E.  
W77-04265

**SEDIMENT YIELD-RUNOFF-DRAINAGE AREA RELATIONSHIPS IN THE UNITED STATES,**  
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.

For primary bibliographic entry see Field 2J.  
W77-04272

**SOME THERMAL AND BIOLOGICAL EFFECTS OF FOREST CUTTING IN WEST VIRGINIA,**

West Virginia Univ., Morgantown. Div. of Forestry.

For primary bibliographic entry see Field 5C.  
W77-04273

**NATURAL WATER AND CHEMICAL BUDGETS FOR A SMALL PRECAMBRIAN LAKE BASIN IN CENTRAL CANADA,**  
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.

For primary bibliographic entry see Field 2K.  
W77-04275

**INVESTIGATION INTO METHODS FOR DEVELOPING A PHYSICAL ANALYSIS FOR EVALUATING INSTREAM FLOW NEEDS,**  
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.

For primary bibliographic entry see Field 2E.  
W77-04296

#### EROSION CONTROL,

Soil Conservation Service of New South Wales, Cobar (Australia). P. J. Walker, and D. R. Green.

Agricultural Gazette of New South Wales, Vol. 87, No. 3, p 38-39, June, 1976.

Descriptors: \*Erosion control, \*Soil erosion, \*Land reclamation, \*Soil conservation, \*Australia, Erosion, Erosion rates, Bank protection, Bank erosion, Bank stability, Surface runoff, Crop production, Topsoil, Slopes, Leaching, Rainfall, Precipitation(Atmospheric), Impact(Rainfall), Contour farming, Diversion structures, Vegetation establishment.

Identifiers: \*Water ponding, \*Western Division, Tyne pitting, New South Wales, \*Water spreading.

Soil erosion is a major problem in certain areas of New South Wales, Australia. Various methods of erosion control are discussed briefly, and evaluated. Waterponding is a practice developed for the reclamation of scalded country, predominantly level areas that have lost topsoil through wind and water erosion. A second erosion control method is water spreading, a means of diverting surplus runoff from ridges onto adjacent cleared, cultivated land by the use of graded banks. Another method is contour furrowing, a major advantage of which is that furrows are cheaply constructed. Pitting, another control measure, involves the digging of a series of pits 2 meters long and 1 and one-half meters apart to catch runoff. Diversion tanks, another method, have the secondary purpose of supplying water for livestock. Vegetation establishment also helps to reduce erosion. The particular advantages of these erosion control methods for the Western Division of Australia are presented. (Jamaal-Arizona)  
W77-04315

**HYDROLOGIC MODELING TO DETERMINE THE EFFECT OF SMALL EARTHEN RESERVOIRS ON Ephemeral STREAMFLOW,**  
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 2E.  
W77-04320

**DEPARTMENT OF ECOLOGY,**

Washington State Dept. of Ecology, Olympia. For primary bibliographic entry see Field 6E.  
W77-04358

**POLLUTION CONTROL HEARINGS BOARD SHORELINES HEARINGS BOARD COUNCIL ON ENVIRONMENTAL POLICY,**  
Washington State Pollution Control Hearing Board, Olympia.

For primary bibliographic entry see Field 6E.  
W77-04360

**SEDIMENT PRODUCTION AND INFILTRATION RATES AS AFFECTED BY GRAZING AND DEBRIS BURNING ON CHAINED AND SEEDED PINYON-JUNIPER,**

Utah State Univ., Logan. Dept. of Range Service.

For primary bibliographic entry see Field 4C.  
W77-04393

**RURAL ROAD SYSTEMS AS A SOURCE OF SEDIMENT POLLUTION - A CASE STUDY,**  
North Carolina State Univ., Raleigh. Dept. of Forestry.

For primary bibliographic entry see Field 5B.  
W77-04394

### 5. WATER QUALITY MANAGEMENT AND PROTECTION

#### 5A. Identification Of Pollutants

**ALGAE ABSTRACTS, A GUIDE TO THE LITERATURE, VOLUME 3, 1972-1974.**

Office of Water Research and Technology, Washington, D.C. Water Resources Scientific Information Center.

For primary bibliographic entry see Field 5C.  
W77-04111

**MONITORING GROUNDWATER QUALITY: ECONOMIC FRAMEWORK AND PRINCIPLES,**  
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.

R. L. Crouch, R. D. Eckert, and D. D. Rugg. Environmental Monitoring Series, Report EPA-600/4-76-045, September, 1976. p 97, 31 fig, 47 ref, 1 append.

Descriptors: \*Monitoring, \*Groundwater, \*Economics, Management, Water rights, Adjudication procedure, Water resources, \*Water quality, \*Monitoring, Waste disposal, Pollutant identification.

Identifiers: Economic framework, Management methods.

In principle, there are two ways to prevent excessive pollution of groundwater: (1) By government intervention in the effluent discharge process, and (2) the property rights to groundwater can be respecified so that they approach more closely the requirements of a well-specified property right. The major reason the Nation's groundwater may become excessively polluted is that property rights in groundwater are poorly specified and so do not effectively protect aquifers against unauthorized use. Consequently, the capacity of aquifers to assimilate waste is being abused and uncompensated damages, or external costs, are being imposed on

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

the owners of the resource. An optimal monitoring strategy must be selected assuming the government intends to combat the excessive pollution of groundwater by (1) setting, and (2) enforcing groundwater quality standards by some form of direct regulations involving discharge licenses or permits. In general, it is analytically incorrect to argue that pollution should be eliminated. As with most other things, there is an optimal amount of pollution. The burden placed upon regulatory authorities is to design institutional arrangements which will achieve that optimum. (Heiss-NWWA) W77-04113

**THE BACTERIOLOGICAL EXAMINATION OF GROUNDWATER SOURCES IN BETUL DISTRICT, MADHYA PRADESH, INDIA.**  
E.L.C. Water Development Project, Betul (India).  
For primary bibliographic entry see Field 5B.  
W77-04123

**A NOTE ON AN IN SITU GROUNDWATER SAMPLING PROCEDURE**  
Nebraska Univ., Lincoln. Div. of Natural Resources, Conservation and Survey.  
R. F. Spalding, M. E. Exner, and J. R. Gormly.  
Water Resource Research, Vol. 12, No. 6, p 1319-1321, December, 1976. 2 fig, 1 ref.

Descriptors: \*Sampling, \*Samplers, \*Groundwater, Water pollution, Well casings, \*Pollutant identification.

Identifiers: \*In situ sampling, PVC pipe.

In situ groundwater sampling can be a relatively economical procedure for measuring time, spatial and vertical changes in ground-water quality. The sampling technique cited allows large samples (1.1 liters) to be collected from a 2 foot vertical interval of the ground-water column. This sampling technique allows the quantification of the nature of groundwater contamination and allows for interpretation of a real sources and the extent of contamination. (Heiss-NWWA)  
W77-04127

**PRELIMINARY ASSESSMENT OF SUSPECTED CARCINOGENS IN DRINKING WATER, REPORT TO CONGRESS.**

Environmental Protection Agency, Washington, D.C. Office of Toxic Substances.  
December, 1975. 52 p.

Descriptors: \*Water pollution, \*Potable water, \*Organic wastes, \*Inorganic compounds, \*Pesticides, Toxins, Monitoring, Water treatment, Regulations, Water policy.

Identifiers: \*Carcinogens, National Organics Reconnaissance Survey.

During 1975 the environmental Protection Agency undertook an extensive program to characterize the nature of drinking water problems. One step, initiated in November 1974, was the National Organics Reconnaissance Survey designed to provide an estimate of the nationwide distribution of organics in drinking water. Several studies are underway to investigate the toxicity of selected inorganics, pesticides, asbestos, and radioactivity when ingested. November 1975 data identifies 253 different specific organic chemicals in drinking water in the United States. Some of these chemicals have been classified as carcinogens or suspected carcinogens by bioassay experiments. Among the identified sources of these organic chemicals compounds are industrial and municipal discharges, urban and rural runoff, natural sources and water and sewage chlorination practices. Future monitoring will be required to demonstrate conclusively that the environmental contamination found was likely to be present nationwide. Such information is a prerequisite for promulgating maximum contaminant levels for specific contaminants. Health effect research, new analytical methodology, water treatment research and future regulation considerations were also covered. (Heiss-NWWA)

W77-04135

**ENTEROBACTERIACEAE FOUND IN RIVER WATER, (IN SPANISH)**  
Chile Univ., Santiago.  
G. Castillo, and A. M. Cordonio.  
Rev Latinoam Microbiol 17(4), p 213-219, 1975.

Descriptors: \*Sampling, \*Enteric bacteria, \*Pollutant identification, Coliforms, \*Salmonella, Isolation, Rivers, Canals, South America, Water pollution source.

Identifiers: \*Chile, \*Mapocho River(Chile), Salmonella-anatum, Salmonella-bareilly, Salmonella-enteritidis, Salmonella-london, Salmonella-paratyphi, Salmonella-senftenberg, Salmonella-thompson, Salmonella-typhimurium, \*Canal Las Mercedes(Chile).

In 1972 and 1973, 113 samples from the Mapocho River and Canal Las Mercedes (Chile) were analyzed. Of the samples, 80% had a most probable number (MPN) of 104-108 fecal coliforms/100 ml. Salmonella were detected in 42% of the samples. Serotypes isolated were S. paratyphi B, S. anatum, S. typhimurium, S. bareilly, S. enteritidis, S. senftenberg, S. london, S. thompson and Group K Salmonellae. Several serotypes were simultaneously isolated from some samples.—Copyright 1976, Biological Abstracts, Inc.  
W77-04138

**\*ANALYSIS, CHARACTERIZATION, AND EFFECTS OF HEAVY METAL CHELATING AGENTS IN WATER**,  
Missouri Univ.-Columbia. Dept. of Chemistry.  
S. E. Manahan.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 286, Price codes: A09 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, Rolla, Completion Report, August 15, 1976. 177 p, 20 fig, 12 tab, 127 ref. OWRT B-095-MO(8), 14-31-0001-4099.

Descriptors: \*Chelation, \*Chromatography, \*Heavy metals, \*Copper, Analytical techniques, \*Chemical analysis, \*Pollutant identification, Spectrophotometry, Nitrilotriocetic acid.

Identifiers: Aminocarboxylic acids, High speed liquid chromatography.

A study was made of chelating agents in natural waters and wastewaters. Emphasis was placed upon the chemical analysis of total chelating agent capacity and specific chelating agents. The primary chemical analysis technique used consists of a high pressure liquid chromatograph for the separation of copper chelates coupled with an atomic absorption spectrophotometer for the detection of copper. This enables analysis of specific chelating agents bound to copper in mixtures containing materials which would obscure the compounds when conventional detection methods are used.  
W77-04141

**AN IMPROVED MEMBRANE FILTER METHOD FOR THE ENUMERATION OF PHYTOPLANKTON**,  
B. J. Dozier, and P. J. Richerson.

Verhandlungen Internationale Vereinigung Limnologie, Vol. 19, Part II, p. 1524-1529, 1975. 3 tab., 5 ref. NSF GA-34099.

Descriptors: \*Laboratory tests, \*Phytoplankton, \*Analytical techniques, Bioassay, Laboratory equipment, Microscopy, California, Nevada, Assay, Distribution, \*Pollutant identification, \*Filters.

Identifiers: \*Membrane filter method, Cyclotella stelligera, Lake Tahoe(Calif-Nevada).

The technique described offers two important modifications to the usual membrane filter method. The first modification is a reduced

vacuum pressure of only 1 psi or less, which prevents destruction and minimizes distortion to the fragile forms by the filtration process. The other modification is substitution of 50% glutaraldehyde for the clearing agents usually used, such as cedarwood oil, immersion oil, anisole, and acetone vapor. Because glutaraldehyde is water soluble, it can be applied to the wet filter immediately following filtration, eliminating the need for an ethanol dehydration step. The new method is an offshoot of research initiated earlier, in which over 1,000 phytoplankton samples had to be enumerated as part of an investigation into the relationship between phytoplankton community structure and physical processes in Lake Tahoe (California-Nevada). Results are given of experiments performed to investigate organism distribution on filters prepared by the new method, using several techniques involving equipment distinguished by funnel shape. Statistical results are given, in addition, for a comparison of counts of 10 filtered and 10 sedimented samples, including mean, variance, variance:mean, chi-square and pattern description. (Harris-Wisconsin)  
W77-04151

**PROCEEDINGS: BIOSTIMULATION AND NUTRIENT ASSESSMENT WORKSHOP**,  
Pacific Northwest Environmental Research Lab., Corvallis, Oreg.  
For primary bibliographic entry see Field 5C.  
W77-04153

**RESEARCH PERTAINING TO DETERMINATION OF ATP IN SOILS AND SUBSURFACE FORMATIONS**,  
Robert S. Kerr Environmental Research Lab., Ada, Okla.

W. R. Duffer, W. J. Dunlap, and J. McNabb.  
In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 1-3. 2 ref.

Descriptors: \*Measurement, \*Soils, \*Bottom sediments, \*Biodegradation, Methodology, Assay, Chromatography, \*Pollutant identification.

Identifiers: \*Adenosine triphosphate(ATP).

To determine the biodegradation potential of land applied wastes, waste waters, and groundwater pollutants, it is essential to measure the adenosine triphosphate content in soils, bottom sediments, and subsurface formations with substantial sensitivity. Attempts to develop a relatively simple and rapid column chromatographic procedure for purification of ATP in acid extracts of soil materials were unsuccessful because of failure to achieve satisfactory separation of ATP from impurities on reasonably sized columns or because of unacceptable ATP loss to sorption on the columns. ATP was effectively retained on Bio Rad AG 11 A8 ion retardation resin when applied to the column in 0.6 normality sulfuric acid solution and during subsequent water elution, and appears relatively easily eluted from these columns by 0.2 mole to 1 mole ammonium chloride and tris-hydroxymethyl aminomethane hydrochloride. Although ammonium chloride and tris-hydrochloride in concentrations required for ATP elution from the ion retardation resin interfere somewhat with the luciferin-luciferase reaction, this procedure appears to offer some promise for improving the sensitivity of ATP analysis in terrestrial materials. Further investigations were being conducted. (See also W77-04153) (Auen-Wisconsin)  
W77-04154

**TOXICITY OF ZINC TO THE GREEN ALGA SELENASTRUM CAPRICORNUTUM AS A FUNCTION OF PHOSPHORUS OR IONIC STRENGTH**,  
Pacific Northwest Environmental Research Lab., Corvallis, Oreg.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

For primary bibliographic entry see Field 5C.  
W77-04156

#### ALGAL ASSAYS FOR THE NATIONAL EUTROPHICATION SURVEY, Pacific Northwest Environmental Research Lab., Corvallis, Oreg.

A. Katko.  
In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore. Report No. EPA-660-3-75-034, June 1973. p. 44-52. 1 fig., 2 tab.

Descriptors: \*Bioassay, \*Algae, \*Eutrophication, \*Surveys, Methodology, \*Sampling, Water quality, \*Lakes, Pollutant identification, \*Monitoring, Data collections.

Identifiers: Eutrophication survey.

A brief overview of the national survey of 800 lakes is given, including a description of efforts to determine each lake's trophic status and water quality characteristics, and the nutrient sources and methods for their elimination/reduction, particularly those nutrients originating from waste treatment facilities. The results will be the basis for joint EPA-state recommendations for corrective or preventive action. Procedures used in the algal assays and preliminary findings on 200 lakes are summarized. Based on the surveys of lakes in ten states, those which were most enriched were nitrogen-limited while those which had the best water quality were phosphorus limited. Occasionally, nitrogen and phosphorus together were required to substantially stimulate a growth response in the algal assay. The assays indicated that approximately 57% of the lakes were phosphorus-limited, 37% were nitrogen-limited, and 1% were limited by some other element or toxicant; however, the sampling was biased in that the majority of these lakes received municipal waste effluents. One of the difficulties which had not been completely resolved is how the assay results can be related to actual field conditions and to lake problems or trophic level classification. (See also W77-04153) (Auen-Wisconsin)  
W77-04157

#### THE USE OF ALGAL ASSAYS TO DETERMINE EFFECTS OF WASTE DISCHARGES IN THE SPOKANE RIVER SYSTEM, Pacific Northwest Environmental Research Lab., Corvallis, Oreg.

For primary bibliographic entry see Field 5C.

W77-04159

#### EFFECT OF NITROGEN AND PHOSPHORUS ON THE GROWTH OF *SELENSTRUM CAPRICORNUTUM*, Pacific Northwest Environmental Research Lab., Corvallis, Oreg.

For primary bibliographic entry see Field 5C.

W77-04160

#### THE USE OF IN SITU ALGAL ASSAYS TO EVALUATE THE EFFECTS OF SEWAGE EFFLUENTS ON THE PRODUCTION OF SHAGAWA LAKE PHYTOPLANKTON, Pacific Northwest Environmental Research Lab., Corvallis, Oreg.

For primary bibliographic entry see Field 5C.

W77-04161

#### GROWTH REQUIREMENTS OF EN- TEROMORPHA COMPRESSA AND CODIUM FRAGILE, Environmental Research Lab., Narragansett, R.I.

For primary bibliographic entry see Field 5C.

W77-04162

GREAT LAKES NUTRIENT ASSESSMENT,  
National Environmental Research Center, Grosse Ile, Mich. Grosse Ile Lab.  
For primary bibliographic entry see Field 5C.  
W77-04163

#### ASSESSING TREATMENT PROCESS EFFICIENCY WITH THE ALGAL ASSAY TEST, Robert S. Kerr Environmental Research Lab., Ada, Okla.

For primary bibliographic entry see Field 5D.

W77-04164

#### OIL BIOASSAYS WITH THE AMERICAN OYSTER, *CRASSOSTREA VIRGINICA* (Gmelin), Texas A and M Univ., College Station.

For primary bibliographic entry see Field 5C.

W77-04189

#### APPLICATION OF ESTIMATION THEORY TO DESIGN OF SAMPLING PROGRAMS FOR VERIFICATION OF COASTAL DISPERSION PREDICTION,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5B.

W77-04193

#### ATMOSPHERIC TRACE METALS OVER THE NEW YORK BIGHT,

National Oceanic and Atmospheric Administration, Boulder, Colo. Marine Ecosystems Analysis Program Office.

For primary bibliographic entry see Field 5B.

W77-04195

#### FIRST DATA ON THE PRESENCE OF SOME METALLIC ELEMENTS IN *MYtilus galloprovincialis*, LAM. OF THE EASTERN SICILIAN COAST, REVEALED BY ATOMIC ABSORPTION SPECTROPHOTOMETRY, (IN ITALIAN), Catania Univ. (Italy).

A. Castagna, and F. Sarro.

Boll Soc Ital Biol Sper 51(8), p 477-483, 1975.

Descriptors: \*Spectrophotometry, \*Pollutant identification, Coasts, \*Heavy metals, Industrial wastes, Copper, Cadmium, Organic compounds, \*Oil pollution, Water pollution sources, California, Bays, Shellfish, Nickel, Molybdenum, Absorption spectrophotometry, Pigments, Respiration.  
Identifiers: \*Atomic, Cyanin, \*Mytilus-galloprovincialis, New Zealand, \*Italy(Sicilian coast).

In a preliminary effort to evaluate the presence of heavy metal contamination in various zones on the east coast of Sicily (Italy), specimens of a local mussel, *M. galloprovincialis* were collected in sea water at 3 locations: Priolo (Syracuse), where there is a major petrochemical industry, the port of Catania and the Bay of Ogina. The contents of 7 heavy metals were determined by atomic absorption spectrophotometry. Highest Cd and Cu values were found in Priolo, compared with the other 2 locations, but the 2 metals found in largest amounts were Mo and Ni. Compared with values reported in shellfish (*M. edulis*) in California (USA) and New Zealand, the Sicilian values were not especially high. Cu is a normal constituent of hemocyanin, the respiratory pigment of mollusks. Present information is insufficient to establish a clear correlation between the values found and the polluting effect of local petrochemical factories, though such a correlation is suspected.—Copyright 1976, Biological Abstracts, Inc.

W77-04207

GROUND-WATER RESOURCES OF THE BARRE-MONTPELIER AREA, VERMONT,  
Geological Survey, Montpelier, Vt. Water Resources Div.

For primary bibliographic entry see Field 4B.  
W77-04222

#### WATER RESOURCES OF SOUTH-CENTRAL MISSOURI, Geological Survey, Rolla, Mo. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04223

#### WATEQF-A FORTRAN IV VERSION OF WATEQ, A COMPUTER PROGRAM FOR CALCULATING CHEMICAL EQUILIBRIUM OF NATURAL WATERS, Geological Survey, Reston, Va. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04226

#### WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 2, SUSQUEHANNA AND POTOMAC RIVER BASINS.

Geological Survey, Harrisburg, Pa. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04228

#### WATER RESOURCES OF THE BIG FORK RIVER WATERSHED, NORTH-CENTRAL MINNESOTA, Geological Survey, Grand Rapids, Minn. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04233

#### WATER RESOURCES OF THE BIGHORN BASIN, NORTHWESTERN WYOMING, Geological Survey, Cheyenne, Wyo. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04235

#### MAP SHOWING GROUND-WATER CONDITIONS IN THE ARAVIA VALLEY AREA, GRAHAM AND PINAL COUNTIES, ARIZONA-1975, Geological Survey, Tucson, Ariz. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04236

#### GEOLOGY AND GROUND-WATER RESOURCES OF NORTHERN MERCER COUNTY, PENNSYLVANIA, Geological Survey, Harrisburg, Pa. Water Resources Div.

For primary bibliographic entry see Field 2F.  
W77-04239

#### WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 1, DELAWARE RIVER BASIN.

Geological Survey, Harrisburg, Pa. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04242

#### WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 3, OHIO RIVER AND ST. LAWRENCE RIVER BASINS.

Geological Survey, Harrisburg, Pa. Water Resources Div.

For primary bibliographic entry see Field 7C.  
W77-04243

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

**NATURAL WATER AND CHEMICAL BUDGETS FOR A SMALL PRECAMBRIAN LAKE BASIN IN CENTRAL CANADA,**  
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.  
For primary bibliographic entry see Field 2K.  
W77-04275

**X-RAY ANALYSIS OF SHORTENED BACKBONES IN FISHES: A COD (GADUS MORHUA L.) AND B. ALLIS SHAD (ALOSA ALOSA L.), (IN GERMAN),**  
Erlangen-Nuremberg Univ. (West Germany). Zoologisches Institut.  
W. Wunder.  
Arch Hydrobiol 75(3), p 366-401, 1975.

Descriptors: \*X-ray analysis, Sewage effluents, \*Industrial wastes, Fish, \*Fish diseases, Toxicity, Chemical wastes, Toxicity, \*Pollutant identification, Water pollution effects.  
Identifiers: Alosa-Alosa, \*Cod, Gadus-Morhua, \*Germany, \*Shad.

Near Cuxhaven (W. Germany) industrial sewage water affects sea life. X-ray pictures of the spines of fishes show pathological deformities of the vertebrae and of the spinal discs characteristic of toxic osteosclerosis. The same changes are seen in the spines of men, house pets and laboratory animals damaged by certain chemicals.—Copyright 1976, Biological Abstracts, Inc.  
W77-04278

**POTENTIAL IMPACT OF THE DEVELOPMENT OF LIGNITE RESERVES ON WATER RESOURCES OF EAST TEXAS,**  
Texas A and M Univ., College Station. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5B.  
W77-04297

**EFFECT OF INDOLE ACETIC ACID PRESOAKING OF SEEDS AND THE QUALITY OF WATER APPLIED ON LEVELS OF AMINO ACIDS IN ARACHIS HYPOGEA,**  
Rajasthan Coll. of Agriculture, Udaipur (India). Dept. of Soil Science and Agricultural Chemistry.  
For primary bibliographic entry see Field 3C.  
W77-04318

**BASELINE STUDIES OF DELAWARE OCEAN OUTFALL SITES,**  
Delaware Univ., Lewes. Coll. of Marine Studies. D. Maurer, J. C. Tinsman, W. Leathem, and P. Kinner.  
Marine Pollution Bulletin, Vol 7, No 2, p 31-34, February, 1976. 1 fig, 7 ref.

Descriptors: \*Water quality control, \*Baseline studies, Sewage treatment, \*Delaware, \*Design, \*Sampling, \*Analytical techniques, Waste treatment, Sewage effluents, Water pollution treatment, Invertebrates, Environmental effects, \*Outlets, Waste disposal.

A quarterly sampling program was conducted during 1973-1974 off the coast of Delaware to provide an environmental baseline for two ocean sewage outfalls. Extensive physical measurements and water quality data, together with biological data (fish, invertebrates, bacteriological samples), were collected. Based on this research the design of sewage treatment for one of the outfalls was improved. (Katz)  
W77-04330

**EXAMINATION OF THE FLUORIDE CONCENTRATION IN DRINKING WATER OF THE TOWN OF TITOGRAD, (IN SERBO-CROATIAN),**  
Medisinskii Institut, Titograd (Yugoslavia). S. Filipovic.

Glas Repub Zavoda Zast Prir Prir Muz Titogradu 8, p 141-149, 1975.

Descriptors: \*Fluorides, \*Potable water, \*Sampling, Pollutant identification, Water analysis.  
Identifiers: \*Yugoslavia (Titograd).

In 1971-1973 in Titograd, Yugoslavia, 50 drinking water samples were found to have low fluoride concentrations.—Copyright 1976, Biological Abstracts, Inc.  
W77-04334

**LEVELS OF PCB AND TRACE METALS IN WATERFOWL IN NEW YORK STATE,**  
New York State Dept. of Health, Albany.

F. D. Baker, C. F. Tumasonis, W. B. Stone, and B. Bush.  
New York Fish and Game Journal, Vol 23, No 1, p 82-91, January 1976. 1 fig, 2 tab, 15 ref.

Descriptors: \*Path of pollutants, \*Polychlorinated biphenyls, \*Trace elements, \*Heavy metals, \*Waterfowl, \*Greater Scaup Duck, \*White winged Scoter, \*Bufflehead Duck, \*Lead, \*Mercury, \*Absorption, \*New York, Ducks (Wild), Water birds, Cadmium, Beryllium, Arsenic compounds, Aquatic life, Birds, Analytical techniques, Chlorinated hydrocarbon pesticides.

Selected tissues of seven species of waterfowl were analyzed for the presence of polychlorinated biphenyls (PCB) and trace metals. The greater scaup, whitewinged scoter and bufflehead were species in whose tissues PCB was consistently found. Values above the detectable limits were obtained infrequently when tissues were analyzed for cadmium, beryllium and arsenic. Lead and mercury were present in many specimens whose diet included both aquatic and animal life. Results indicate that periodic and more extensive sampling would be useful. (Katz)  
W77-04336

**MOBILE METHOD OF DETERMINING FLUORIDES IN DRINKING WATER, (IN RUSSIAN),**

Central Lab. of the Waterworks Administration, Yaroslavl (USSR). A. I. Abrosimov.  
Gig Sanit 11, p 101-103, 1975.

Descriptors: \*Fluorides, \*Potable water, \*Pollutant identification, Methodology, Water sampling, Water analysis.

A proposed modification permits determining 0.05-2.00 mg/l F- in a 1.0 cm thick cuvette within 5 min after adding to the water sample reagents A (alizarin red C) and B (zirconium oxychloride or zirconium nitrate). To correct the dose of F- during fluoridation of water the proposed method determining F-, used for 5 yr, gives the result in the shortest time.—Copyright 1976, Biological Abstracts, Inc.  
W77-04337

**RESIDUE DYNAMICS OF DI-2-ETHYLHEXYL PHTHALATE IN FATHEAD MINNOWS (PIMEPHALES PROMELAS),**

Fish and Wildlife Service, Columbia, Mo. Fish-Pesticide Research Lab.  
For primary bibliographic entry see Field 5C.  
W77-04338

**BIOASSAYS ON THE COMBINED EFFECTS OF CHLORINE, HEAVY METALS, AND TEMPERATURE ON FISHES AND FISH FOOD ORGANISMS. PART I. EFFECTS OF CHLORINE AND TEMPERATURE ON JUVENILE BROOK TROUT (SALVELINUS FONTINALIS),**  
Battelle-Pacific Northwest Labs., Richland, Wash. Ecosystems Dept.

For primary bibliographic entry see Field 5C.  
W77-04339

**THE USE OF RECOVERY AS A CRITERION FOR TOXICITY,**  
University Coll. of North Wales, Menai Bridge. Marine Science Labs.

A. Wright.  
Bulletin of Environmental Contamination and Toxicology, Vol. 15, No. 6, p. 747-749, 1976. 1 fig., 3 ref.

Descriptors: \*Toxicity, \*Bioassay, \*Surfactants, Methodology, \*Mortality, \*Water pollution effects, \*Analytical techniques, Swimming, \*Crustaceans, Mode of action, Toxicants, Laboratory tests, Environmental effects, Pollutant identification.  
Identifiers: Recovery, \*Elminius sp.

State II nauplii of the barnacle *Elminius modestus* were exposed to various nonionic, anionic and cationic surfactants to determine the 30 min. EC50's producing immobility. On the basis of these tests, the relative toxicities of the different decyl surfactants would be in descending order, nonionic greater than anionic greater than cationic. In order to simulate environmental conditions in which concentrations of toxins would fluctuate and allow for recovery of the organism, nauplii were exposed to equitoxic concentrations of the decyl surfactants for thirty minutes and then placed in aerated sterile sea water. Observations of the condition of the nauplii for up to 48 hours showed lowest recovery from exposure to cationic surfactants, followed by anionic and nonionic. This sequence is the complete reverse of that determined on the basis of the 30 min. EC50's. (Katz)  
W77-04340

**DATA TO SUBSTANTIATE THE PERMISSIBLE CONCENTRATION OF FENURON IN WATER BODIES, (IN RUSSIAN),**

Kirgiz Research Inst. of Epidemiology, Microbiology and Hygiene, Frunze (USSR). V. M. Perelygin, K. K. Vrochinskii, and E. D. Perlovskaya.  
Gig Sanit 10, p 22-25, 1975.

Descriptors: \*Lethal limit, \*Toxicity, Water quality standards, Water pollution effects, Public health, Rodents, Tests, Pollutant identification.  
Identifiers: \*Fenuron.

In warm-blooded animals (rats and guinea pigs) toxic doses of fenuron produced disturbances in the endocrine and blood-forming systems, changes in immunologic reactivity, blockage of blood SH-groups and diminished body weight increases. In a chronic toxicologic test the threshold dose of fenuron amounted to 15 mg/kg and the subthreshold one amounted to 1.5 mg/kg. The suggested permissible concentration of fenuron in water bodies used by man is 0.2 mg/l, according to its limiting index, i.e., its effect on the sanitary regimen of the water body.—Copyright 1976, Biological Abstracts, Inc.  
W77-04407

**DISSOLVED GAS DATA REPORT, 1974, COLUMBIA AND LOWER SNAKE RIVERS,**  
Army Engineer Div. North Pacific, Portland, Ore.

D. L. Legg, K. Avery, and D. Yadoff.

November, 1975. 51 p, 21 tab., 13 fig., 3 ref.

Descriptors: \*Columbia River, Grand Coulee Dam, \*Supersaturation, \*Monitoring, On-site investigations, Water quality, \*Dam, Dam sites, \*Nitrogen, Data collection, On-site data collection, Stream flow, Water temperature.

Identifiers: 1974 high flow, Nitrogen supersaturation, Chief Joseph Dam, Wells Dam, Rocky Reach Dam, Rock Island Dam, Wanapum Dam, Priest Rapid Dam, Little Goose Dam, Lower Monumen-

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

tal, Ice Harbor Dam, McNary Dam, John Day Dam, The Dalles, Bonneville Dam, Lower Snake River.

In recent years there has been increased attention on the problem of dissolved gas in the Columbia and Snake Rivers, particularly with regard to its effect on aquatic life. This report was prepared to present the dissolved gas, and associated streamflow and water temperature data which were collected during the 1974 high flow period of the Columbia River. Also, there is a brief summary of significant events which affected the levels of dissolved gas supersaturation. Graphic displays are included which aid the researcher as well as the layman to visualize the reported levels of dissolved gas at specified locations. (Katz) W77-04408

**LOWER COLUMBIA AND LOWER SNAKE RIVERS, NITROGEN (GAS) SUPERSATURATION AND RELATED DATA, ANALYSIS AND INTERPRETATION,** Army Engineer Div. North Pacific, Portland, Ore.

For primary bibliographic entry see Field 5C. W77-04411

**GAS BUBBLE DISEASE, PROCEEDINGS OF A WORKSHOP HELD AT RICHLAND, WASHINGTON, OCT. 8-9, 1974.**

Battelle-Pacific Northwest Labs, Richland, Wash. For primary bibliographic entry see Field 5C. W77-04413

**GAS SUPERSATURATION RESEARCH, NATIONAL MARINE FISHERIES SERVICE PRESCOTT FACILITY - 1971 TO 1974,**

National Marine Fisheries Service, Seattle, Wash. Environmental Conservation Div.

For primary bibliographic entry see Field 5C. W77-04415

**DISSOLVED GAS SUPERSATURATION: LIVE CAGE BIOASSAYS OF ROCK ISLAND DAM, WASHINGTON,**

Parametrix, Inc., Bellevue, Wash. Environmental Services Section.

For primary bibliographic entry see Field 5C. W77-04417

**CONTINUOUS MONITORING OF TOTAL DISSOLVED GASES, A FEASIBILITY STUDY,**

Cold Regions Research and Engineering Lab., Hanover, N. H.

For primary bibliographic entry see Field 5C. W77-04430

**AN ELECTRONIC MONITOR FOR TOTAL DISSOLVED GAS PRESSURE,**

Virginia Mason Research Center, Seattle, Wash.

For primary bibliographic entry see Field 5C. W77-04431

**ANALYTICAL METHODS,**

Battelle-Pacific Northwest Labs., Richland, Wash. Ecosystems Dept.

For primary bibliographic entry see Field 5C. W77-04434

**SALMONID BIOASSAY OF SUPERSATURATED DISSOLVED AIR IN WATER,**

National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.

For primary bibliographic entry see Field 5C. W77-04440

**NITROGEN SATURATION LEVELS ON THE MID-COLUMBIA RIVER, 1965-1971,**

Washington Dept. of Fisheries, Olympia.

For primary bibliographic entry see Field 5C. W77-04442

**ONE CHEMICAL COMPANY'S APPROACH TO THE PROBLEM,**

Hickson and Welch, Ltd., Castleford, (England).

I. G. McKenzie.

Chemistry and Industry, No. 19, p 819-821, October, 1976. 3 fig.

Descriptors: \*Pollutant identification, \*Sewage treatment, \*Treatment facilities, \*Waste water treatment, \*Waste water disposal, Waste identification, Industrial wastes, Aromatic compounds, Chemical wastes.

The steps taken by Hickson and Welsh Limited, a chemical company, to produce a waste effluent appropriate for treatment by a municipal facility and disposal into a river were documented. For years the company extracted cooling water upstream and discharged it downstream mixed with process effluent. There was a variety of aromatic compounds in the effluent and a great variation in effluent content. In the 1960's, disposal practices were revised. Cooling water and waste effluent were separated so that the former could be returned to the river and the latter treated. When an area Water Authority was established, it and the company worked together to investigate improved methods of handling waste effluents. The company established a laboratory to determine biodegradability and other properties of wastes from present and future products. The Water Authority also made extensive tests in its facilities. With better treatment systems at the plant and at municipal works, the river was less polluted because collection was more effective, the sewage treatment works accepted all the effluent, and there was less pollution from the sewage works. One problem presented was that some of the industrial waste streams inhibited the local sewage treatment process. Methods were developed to detoxify these streams. (Collins-FIRL) W77-04446

**ENVIRONMENTAL TOXICITY OF AQUATIC RADIONUCLIDES: MODELS AND MECHANISMS.**

Rochester Univ., N.Y.

For primary bibliographic entry see Field 5C. W77-04508

**MEASUREMENTS FOR MODELING RADIONUCLIDE TRANSFER IN THE AQUATIC ENVIRONMENT,**

Georgia Inst. of Tech. Atlanta. Environmental Resources Center.

For primary bibliographic entry see Field 5B. W77-04515

**THE BEHAVIOR OF PLUTONIUM NUCLIDES IN THE IRISH SEA,**

Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.

For primary bibliographic entry see Field 5C. W77-04518

**BIOLOGICAL ACTION OF NITRATES IN DRINKING WATER, (IN RUSSIAN),**

Kazanskii Gosudarstvennyi Meditsinskii Institut (USSR). Inst. of Public Hygiene.

A. V. Inanov, N. I. Petukhov, and N. Sh.

Shamsutdinov.

Gig Sanit 12, p 9-11, 1975.

Descriptors: \*Nitrates, \*Potable water, Rodents, Water pollution effects, Tests, \*Lethal limit, \*Toxicity, Water quality standards, Pollutant identification.

Nitrates at a concentration of 105 mg/l diminish the immunologic reactivity and affect the formation of the conditioned reflex activity in albino rats. Smaller doses of nitrates (40 mg/l) have no negative effect on the body and this proves the safety of the existing hygienic standard values for nitrates in the drinking water.—Copyright 1976, Biological Abstracts, Inc. W77-04560

**PIKE AS THE TEST ORGANISM FOR MERCURY, DDT AND PCB POLLUTION. A STUDY OF THE CONTAMINATION IN THE STOCKHOLM ARCHIPELAGO,**

Naturhistoriska Riksmuseet, Stockholm (Sweden).

For primary bibliographic entry see Field 5C. W77-04569

**DETERMINATION OF NANOGRAM QUANTITIES OF CARBONYL COMPOUNDS USING TWIN CELL POTENTIAL SWEEP VOLATMETRY,**

Canada Centre for Inland Waters, Burlington (Ontario).

B. K. Afghan, A. V. Kulkarni, and J. F. Ryan. Analytical Chemistry, Vol. 47, No. 3, p. 488-494, 1975. 6 fig., 4 tab., 30 ref.

Descriptors: \*Laboratory tests, \*Analytical techniques, \*Polarographic analysis, \*Colorimetry, \*Fluorometry, Alcohols, Gases, Corrosion, Odor, Taste, Industrial wastes, Pollutant identification, \*Organic compounds.

Identifiers: \*Carbonyls, \*Twin Cell Potential Sweep Voltammetry, Aldehydes, Ketones, Formaldehyde.

An improved method is described which determines and differentiates various classes of carbonyl compounds, i.e., those aldehydes and ketones which induce strong tastes, odors, corrosion and related problems, in waters and industrial effluents. The method was developed because of shortcomings in the fluorometric and colorimetric procedures used to isolate these compounds in a preliminary laboratory survey. These methods gave reasonably accurate results for relatively clean waters, but were not suitable for industrial effluents and receiving waters. The systematic study reports the polarographic behavior of carbonyl compounds in various media, such as alkaline medium, citrate buffer, various amines, and the formation of azomethine derivatives by the reaction of various carbonyls with a variety of amines and the utilization of the most favorable azomethine derivative to determine formaldehyde and related compounds. Twin cell potential sweep voltammetry was found to be the most sensitive and fastest technique for routine analysis as individual carbonyl compounds can be determined down to 0.25 microgram/l without any separation or preconcentration of the sample. This technique was operated in both the subtractive and the eliminative mode to obtain the desired selectivity and sensitivity. Relatively low carbonyl concentrations were found in most waters but some industrial effluents contained high levels of formaldehyde and related compounds. (Auen-Wisconsin) W77-04573

**LEVELS OF ARSENIC AND SELENIUM IN THE GREAT LAKES REGION,**

Canada Centre for Inland Waters, Burlington (Ontario).

For primary bibliographic entry see Field 5B. W77-04574

**DETERMINATION OF LITHIUM IN SEAWATER BY FLAME PHOTOMETRY AND ATOMIC ABSORPTION: APPLICATION TO AROSA ESTUARY, (IN SPANISH),**

J. J. G. Fernandez.

Bol Inst Esp Oceanogr 195, p 1-37, 1975.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

Descriptors: \*Pollutant identification, \*Sea water, \*Photometry, Analytical techniques, Estuaries, \*Spectrophotometry.  
Identifiers: \*Lithium, \*Spain, Flame photometry, \*Atomic absorption spectrophotometry, \*Arosa Estuary.

The amount of Li in seawater from the Ria de Arosa, Galicia (Spain) was determined using flame photometry and atomic absorption spectrophotometry. The number of representative samples was 258. Both procedures are compared and their interferences are studied. The results obtained are statistically equivalent. The data are interpreted considering hydrographic and geological conditions of the area studied. Copyright 1976, Biological Abstracts, Inc. W77-04586

#### TASKS AND PRINCIPLES OF BIOLOGICAL ANALYSIS OF THE DEGREE OF POLLUTION OF WATER BODIES, (IN RUSSIAN), Astrakhan State Reservation (USSR).

Y. S. Chukov.  
Gidrobiol Zh 11(5), p 111-118, 1975.

Descriptors: \*Trophic level, \*Energy balance, Water bodies, \*Water pollution, \*Bacteria, Benthos, Ecology, Phytoplankton, Zooplankton, Fish habitats.

Identifiers: \*Biological analysis.

In a study of natural production processes, trophic relations and energy balance in water bodies, the anthropogenic effect must be considered. In hydrobiological, ichthyological and fishery investigations, a biological analysis of the degree of water pollution by an ecological analysis of the habitat is important. A quantitative recording of the components of the biological system (bacteria, phyto- and zooplankton, benthos, etc); establishment of the structure of the communities, isolation of dominant species and determination of the degree of dominance; and analysis of the structure of the dominants should be done. The water pollution level is indicated by the ecology of the dominant and satellite species. Copyright 1976, Biological Abstracts, Inc. W77-04598

#### DATA ON SUBSTANTIATION OF THE MAXIMUM ALLOWABLE CONCENTRATION OF YALAN IN WATER BODIES, (IN RUSSIAN), Vsesoyuzny Nauchno-Issledovatel'skii Institut Gigenii i Toksikologii Pestitsidov, Kiev (USSR). For primary bibliographic entry see Field 5C.

W77-04599

### 5B. Sources Of Pollution

#### EFFECTS OF AGRICULTURAL PRACTICES AND LAND DISPOSAL OF SOLID WASTE ON QUALITY OF WATER FROM SMALL WATERSHEDS, Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.

C. H. Shelton, and G. M. Lessman.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 240, Price codes: A02 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Knoxville, Research Report No. 56, January 17, 1977. 16 p, 9 tab, 8 ref. OWRT A-031-TENN(1), 14-34-0001-6044.

Descriptors: Water quality, \*Agricultural runoff, \*Waste disposal, Fertilizers, Sediments, Runoff, Heavy metals, \*Rainfall-runoff relationships, \*Small watersheds, Land use, \*Tennessee, \*Sampling, Nitrates, Phosphates, Chlorides, Dissolved oxygen, coliforms, Biochemical oxygen demand, Metals.

Samples of runoff water were collected from each of four watersheds as it was subjected to a specific cropping, tillage, fertilization, or waste disposal treatment. Runoff water quality constituents examined include: nitrates, phosphates, chlorides, dissolved solids, sediment, turbidity, suspended matter, BOD, DO, fecal coliform, and 13 selected metals. The data were analyzed by seasons in order to best relate constituent concentrations to watershed and rainfall-runoff conditions. Rainfall and runoff rates and depths were generally highest in the first quarter of the year and decreased with each succeeding quarter. Concentrations of sediment, total suspended matter, total dissolved solids, and turbidity were generally highest during the late winter and early spring, particularly on watersheds which were fallowed. Although concentrations of nitrate nitrogen, chlorides and orthophosphate were not high, increases in concentrations were usually associated with fertilizer applications. With several exceptions, concentrations of metallic elements were reasonably low and uniform throughout the sampling period. The one runoff event having high concentrations of several metals was associated with high antecedent rainfall. This was also true for high fecal coliform and low BOD following application of sewage sludge. High concentrations of Al, Fe, and P compared to known inputs emphasize the need for background information when evaluating effects of land-use practices on water quality. W77-04102

#### INVESTIGATION TO DETERMINE EXTENT AND NATURE OF NON-POINT SOURCE ENRICHMENT AND HYDROLOGY OF SEVERAL RECREATIONAL LAKES OF EASTERN WASHINGTON, (PART I AND PART II), Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.

H. D. Copp, W. H. Funk, H. L. Gibbons, D. Morency, and P. J. Bennett.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 354, Price codes: A15 in paper copy, A01 in microfiche. State of Washington Water Research Center, Pullman, 309 p, 66 tab, 111 fig, 72 ref, 2 append. OWRT A-067 WASH(2), 74-153.

Descriptors: \*Washington, \*Lakes, Recreation, Hydrology, Water balance, Water quality, Limnology, \*Eutrophication, Land management, \*Nutrients, Water pollution sources, \*Path of pollutants, Rainfall-runoff relationships, Productivity.

Identifiers: \*Non-point sources of pollution, \*Newman Lake(Wash), \*Liberty Lake(Wash), \*Williams Lake(Wash).

Three small lakes in eastern Washington state, Newman, Liberty, and Williams, provide centers for recreation activity during summer months. Year around homesites also exist. The quality of lake waters, in each case, can be improved considerably. The water quality is probably influenced by not only recreation but by other activity in the basins as well. This study is an attempt to identify where water that flows into the lakes originates and how much there is. Once this is accomplished, the extent to which nutrients are carried by these waters into the lake, and their fate therein, is assessed. Much of the hydrologic work reported is empirical in nature due to a shortage of hydrologic data. A regional precipitation-runoff relationship, based on analyses by others is used extensively in the basins of the first two above-mentioned lakes. Runoff and precipitation correlations with data at locations outside the basin are incorporated also. The result is a month-by-month tabulation of water occurrences and dispositions in each basin for the long-term mean water year. Extensive water quality and limnological inquiry was made upon each of the three lakes. Point sources of pollution, non-point sources, and geological features in the lake basins are described along with land management practices that currently are enriching these recreational lakes. Baseline data on

nutrients, productivity, and physiochemical parameters will provide management data for other lakes in the region undergoing urbanization pressures. W77-04103

#### HERBICIDE MOVEMENT WITH WATER AND EFFECTS OF CONTAMINANT LEVELS ON NON-TARGET ORGANISMS.

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Plant Pathology and Physiology.

C. L. Foy, and H. Hiranpradit.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 285, Price codes: A06 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Completion report, January 1977. 89 p, 25 tab, 38 fig, 27 ref. OWRT A-046-VA(1).

Descriptors: \*Herbicides, Movement, Algae, Chlorophyll, Runoff, Migration, \*Chlamydomonas, \*Chlorella, \*Scenedesmus, Path of pollutants, Water pollution effects, Corn(Field), Cultivation.

Identifiers: \*Atrazine, \*Simazine, \*Cyanazine, \*Cyprazine.

The effects of atrazine, simazine, cyanazine, and cyprazine on the growth and physiology of Chlamydomonas reinhardtii, Chlorella pyrenoidosa, and Scenedesmus quadricauda were determined in a growth chamber and in the laboratory. Cyprazine appeared to be the most effective chemical in inhibiting growth of the algae. Atrazine was second, simazine was third and cyanazine was fourth. Stimulatory effects of cyanazine, simazine, and cyprazine on the chlorophyll content of Chlamydomonas and Chlorella spp. were observed. Cyanazine exhibited the most stimulatory effect on both species while that of simazine was also obvious. Cyprazine exhibited its stimulatory effect only on Chlamydomonas sp. at 0.052 ppm concentration. The same concentration on Chlorella sp. apparently was inhibitory. Atrazine effect was toward an inhibitory trend. Field studies on the migration and degradative disappearance of atrazine from 'no-tillage' and 'conventionally-planted' corn plots were made. Total atrazine loss with run-off water induced by one sprinkler irrigation was 73.93 mg from conventionally planted, treated plots and 20.01 mg from no-tillage, treated plots. These accounted for 1.7 and 0.5% of the total dosage of applied atrazine, respectively. From conventionally planted plots, the total loss of atrazine with run-off water induced by nine rains was 165.85 mg which accounted for 3.9% of the total dosage of atrazine applied. No such runoff occurred in the no-tillage plots. W77-04104

EFFECTS OF HIGH LEVELS OF INORGANIC PHOSPHATE ON AQUATIC ORGANISMS IN PHOSPHATE-RICH ENVIRONMENTS, Georgia Inst. of Tech., Atlanta. School of Biology. For primary bibliographic entry see Field 5C. W77-04105

#### SEDIMENT AND RUNOFF MEASUREMENTS FOR A TYPICAL GREAT PLAINS PRAIRIE LAKE,

South Dakota State Univ., Brookings. Dept. of Mechanical Engineering.

E. J. Felderman, and B. E. Eno.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 287, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, October 1976. 42 p, 12 fig, 18 ref, 2 append. OWRT A-049-SDAK(1), 14-31-0001-5042.

Descriptors: Lakes, Sedimentation, Runoff, Eutrophication, \*Model studies, Great Plains, \*South Dakota, \*Partical size, Sediments, \*Lake sediments, \*Sediment transport, Water quality, Measurement.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

#### Identifiers: \*Prairie lakes(SD), Lake Herman(SD).

The objective was to gather experimental data which would guide, support, and verify the development of a theoretical predictive model for the prairie lake. Initial efforts to develop the predictive transport model were also carried out under this project. Lake Herman, near Madison, South Dakota, was selected as a test lake because of the considerable amount of data that has already been accumulated for this lake. The sediment particle size data indicated that the large particles are found near the shore while the smaller ones are found toward the lake center. The particle size for the majority of the sediment is small enough so that diffusion effects must be included in a predictive model. Initial efforts to develop a predictive model show the dominance of vertical transport over lateral transport in the shallow prairie lake. A one-dimensional model for the lateral transport was found to predict the trends exhibited by spatial and temporal water quality data taken before and after a heavy rain. (Wiersma-South Dakota State) W77-04108

#### ESTUARINE POLLUTION, A BIBLIOGRAPHY, VOLUME 2.

Office of Water Research and Technology, Washington, D.C. Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 772. Price codes: A25 in paper copy, A01 in microfiche. Water Resources Scientific Information Center, Report OWRT/WRSIC 76-207, December 1976, 576 p.

Descriptors: \*Estuarine environment, \*Bibliographies, Biota, Chesapeake Bay, Coasts, Environmental effects, Estuaries, Mathematical models, Path of pollutants, Radioactivity, Water pollution, Water quality, Water resources development.

Identifiers: \*Estuarine pollution.

This report, containing 366 abstracts, is another in a series of planned bibliographies in water resources produced from the information base comprising SELECTED WATER RESOURCES ABSTRACTS (SWRA). Volume 2 covers the period from January 1973 to April 1974 (Volume 7, Number 7). Author and subject indexes are included. (See also W77-04110 and W73-08451) W77-04109

#### ESTUARINE POLLUTION, A BIBLIOGRAPHY, VOLUME 3.

Office of Water Research and Technology, Washington, D.C.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 773. Price codes: A24 in paper copy, A01 in microfiche. Water Resources Scientific Information Center, Report OWRT/WRSIC 76-208, December 1976, 566 p.

Descriptors: \*Estuarine environment, \*Bibliographies, Biota, Chesapeake Bay, Coasts, Environmental effects, Estuaries, Mathematical models, Path of pollutants, Radioactivity, Water pollution, Water quality, Water resources development.

Identifiers: \*Estuarine pollution.

This report, containing 373 abstracts, is another in a series of planned bibliographies in water resources produced from the information base comprising SELECTED WATER RESOURCES ABSTRACTS (SWRA). Volume 3 covers the period from April 1974 to September 1976 (Volume 9, Number 18). Author and subject indexes are included. (See also W77-04109 and W73-08451) W77-04110

MONITORING GROUNDWATER QUALITY: ECONOMIC FRAMEWORK AND PRINCIPLES, General Electric Co., Santa Barbara, Calif. Center for Advanced Studies. For primary bibliographic entry see Field 5A. W77-04113

LEACHATE DAMAGE ASSESSMENT, CASE STUDY OF THE PEOPLES AVENUE SOLID WASTE DISPOSAL SITE IN ROCKFORD, ILLINOIS, Environmental Protection Agency, Cincinnati, Ohio. Office of Solid Waste Management Programs.

K. A. Shuster  
Report EPA/530/SW-517, June, 1976. p 25, 4 fig, 7 tab, 7 ref, 2 append.

Descriptors: \*Landfills, \*Waste disposal, \*Water pollution, \*Groundwater, Water wells, Industrial wastes, Municipal wastes, Replacement, Administrative costs, Costs, Total costs, Damages, \*Illinois.

Identifiers: \*Landfill leachate, Well abandonment, Rockford(ILL).

The city of Rockford, Illinois operated an unlined, non-engineered landfill site from 1947 to 1972. Initially wastes were placed in groundwater seepage pools in the bottom of the abandoned sand mining pit. These wastes included metal finishing scraps, foundry wastes, household wastes and various wastes collected by private contractors. The landfill was located 700 feet east of the Rock River which was probably the discharge zone of the landfill leachate. Between the river and landfill (an area of approximately 0.24 square miles) 9 wells were contaminated by the landfill leachate. All nine of these wells were eventually abandoned. The State Environmental Protection Agency required the city to place a bottom soil cover on the landfill to increase surface runoff and decrease infiltration the costs of abandonment and additional soil cover totalled \$180,500.00. These expenditures did nothing to clean up the groundwater or to correct the source of contamination. Administrative costs of the State EPA, Health Department, Geological Survey, and Water Survey personnel, or the city of Rockford Public Works Department, Engineering, Council, or Water Department personnel in evaluation and administering corrective and avoidance measures totaled at least \$25,000.00. (Heiss-NWWA) W77-04122

THE BACTERIOLOGICAL EXAMINATION OF GROUNDWATER SOURCES IN BETUL DISTRICT, MADHYA PRADESH, INDIA, E.L.C. Water Development Project, Betul (India).

A. M. Prentice, and G. K. Sharma. January, 1976. p 16, 14 fig, 5 tab, 16 ref, 5 append.

Descriptors: \*Water wells, \*Contamination(Water), \*Sewage bacteria, \*Nitrates, \*Coliforms, Groundwater, Shallow wells, Casing, Cement grouting, Construction materials, Pumps.

Identifiers: \*Tubewells, Damaged pump plinths, Fractured grouting, Well construction, Casing installation, \*India.

Tubewell produced groundwater from the Betul district India, generally may be recommended for drinking in favor of other water sources. No correlation has been found which connects the levels of contamination of the tubewells studied and the depth or nature of the aquifer. Tubewells from densely populated areas are not more heavily contaminated than tubewells in rural areas. A relationship was noted, however, between bacterial and nitrate contents of groundwater from these wells. Contamination of tubewells in the Betul district was found to be most likely in wells with damaged plinths or fracture grouting. This contamination may be eliminated by utilization of well casing of sufficient depth. (Heiss-NWWA) W77-04123

A NOTE ON AN IN SITU GROUNDWATER SAMPLING PROCEDURE, Nebraska Univ., Lincoln. Div. of Natural Resources, Conservation and Survey. For primary bibliographic entry see Field 5A. W77-04127

THE IMPACT OF INTENSIVE APPLICATION OF PESTICIDES AND FERTILIZERS ON UNDERGROUND WATER RECHARGE AREAS WHICH MAY CONTRIBUTE TO DRINKING WATER SUPPLIES. A PRELIMINARY REVIEW, Environmental Protection Agency, Washington, D.C. Office of Toxic Substances. D. Garrett.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 181. Price codes: A06 in paper copy, A01 in microfiche. Report EPA 560/3-75-006, January 1976. p 100, 12 fig, 8 tab, 103 ref.

Descriptors: \*Groundwater, \*Water pollution, \*Nitrates, Nitrogen compounds, Areas, Water pollution sources, Pesticides, Soil structure, \*Feed lots, \*Farm wastes.

Identifiers: Safe Drinking Water Act, Agricultural practices.

The intensive application of pesticides and fertilizers on ground-water recharge areas may contribute to the pollution of drinking water supplies. Additional information is required to define the nature and extent of the impact of agricultural practices on ground-water supplies for public water systems by the Safe Drinking Water Act (PL-93-523). The operation of feedlots represents a significant concern in this area. In addition to being a most concentrated source of potential pollution, feedlots may also offer the greatest range of choices for abatement, some of which may be economically profitable. Pesticides appear to offer only a marginal threat to groundwater due to their adsorptive properties on soil structure and their short lived persistence. The exception to this may occur where pesticides are improperly applied, or there exists sandy or thin soils overlaying fissured rocks. (Heiss-NWWA) W77-04128

GENERATION OF LEACHATE FROM LANDFILLS AND ITS SUBSURFACE MOVEMENT, Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management.

G. H. Enrich, and R. A. Landon.

Presented at Annual Northeastern Regional Anti-Pollution Conference, July, 1969, University of Rhode Island, Providence, p 7, 12 fig, 9 ref.

Descriptors: \*Solid wastes, \*Waste dumps, \*Landfills, Leaching, Biochemical oxygen demand, Illinois, Pennsylvania, Waste disposal, Path of pollutants.

Identifiers: \*Sanitary landfills, \*Leachates, Leachate collection, Leachate treatment, Landfill, Site selection.

Solid waste generation is increasing at a very rapid rate in the United States. Suitable sanitary landfill sites are not available in most major metropolitan areas. Research conducted in Pennsylvania and Illinois indicate that sanitary landfills will invariably produce a leachate. This leachate is 100 times as strong as sewage with initial BOD of over 20,000 milligrams per liter. As leachate moves down through unsaturated earth materials it is renovated. At a depth of 12 feet below the landfill there has been 95% BOD reduction, but it is still stronger than raw sewage and still can cause the pollution of groundwater. It is now necessary to reevaluate our basis for solid waste disposal on the land's surface. Solid waste must be managed in such a manner that we can control the degradation of the immediately adjacent ground water or intercept the leachate at the bottom of the landfill, col-

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

lect it, and treat it. If collection and treatment of leachate is feasible, many more sites will be available for sanitary landfilling than were once considered suitable. (Heiss-NWWA)  
W77-04134

**PRELIMINARY ASSESSMENT OF SUSPECTED CARCINOGENS IN DRINKING WATER, REPORT TO CONGRESS.**  
Environmental Protection Agency, Washington, D.C. Office of Toxic Substances.  
For primary bibliographic entry see Field 5A.  
W77-04135

**SYSTEM PREVENTS LEACHATE FORMATION.**  
For primary bibliographic entry see Field 5G.  
W77-04136

**ENTEROBACTERIACEAE FOUND IN RIVER WATER, (IN SPANISH),**  
Chile Univ., Santiago.  
For primary bibliographic entry see Field 5A.  
W77-04138

**HYDROGEOLOGIC STUDY, NEW HORIZONS SUBDIVISION, CARROLL COUNTY, MARYLAND,**  
Maryland Dept. of Natural Resources, Annapolis. Water Resources Administration.  
For primary bibliographic entry see Field 4B.  
W77-04140

**EFFECTS OF THERMAL POLLUTION ON CERTAIN AQUATIC INVERTEBRATES,**  
Clemson Univ., S. C. Dept. of Zoology.  
For primary bibliographic entry see Field 5C.  
W77-04144

**ARID BASIN MANAGEMENT MODEL WITH CONCURRENT QUALITY AND FLOW CONSTRAINTS-PHASE II,**  
Nevada Univ., Reno. Desert Research Inst.  
For primary bibliographic entry see Field 2A.  
W77-04147

**THE EFFECT OF MASS TRANSPORT ON BIOSTIMULATION OF ALGAL GROWTH,**  
Army Engineers Waterways Experiment Station, Vicksburg, Miss.  
For primary bibliographic entry see Field 5C.  
W77-04155

**FREQUENCY ANALYSIS OF CYCLIC PHENOMENA IN FLOWING STREAMS,**  
Army Engineers Waterways Experiment Station, Vicksburg, Miss.  
For primary bibliographic entry see Field 5C.  
W77-04158

**HEAVY METAL LEVELS IN SUSPENDED PARTICULATES, BIOTA, AND SEDIMENTS OF THE ST. CROIX ESTUARY IN MAINE,**  
Maine Univ., Walpole. Dept. of Oceanography.  
L. K. Fink, Jr., D. M. Pope, A. B. Harris, and L. L. Schick.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 497, Price codes: A04 in paper copy, A01 in microfiche. Maine Land and Water Resources Institute, Orono, Completion Report, ICDC Reference No. 76-22, November 1976. 60 p., 18 fig., 7 tab, 21 ref. OWRT B-010-ME(1), 14-31-0001-5079.

Descriptors: Effluents, \*Estuarine environment, \*Heavy metals, Sediments, Biota, \*Maine, Suspended solids, Estuaries, Pulp wastes, Industrial wastes, Sediment transport, Path of pollutants.

Identifiers: Estuarine environmental impact, Heavy metal accumulation, Sediment cores, \*Suspended particulates, \*St. Croix estuary (Maine).

Results are presented of an investigation to determine the impact of a pulp and paper mill effluent on various environmental compartments of the St. Croix River and Estuary System. The data include 7,940 analyses for ten metals (Ag, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, and Zn) in samples of suspended particulates in water, biota, and sediments from thirty-three sites along the freshwater and marine sections of the St. Croix River. The impact-assessment techniques demonstrate the significance of using sediment cores to increase the understanding of heavy metal transport mechanisms and pathways among compartments in estuaries. Results from sediment cores are highly reproducible and afford a means for (1) assessing factors influencing metal accumulation levels, (2) comparing variable areas, (3) establishing background levels, and (4) defining reference sections for assessing future changes in heavy metal contributions from anthropogenic activities. These conclusions are consistent with theoretical predictions based on the carrier-reservoir equilibrium model proposed as a working concept for this study. The sequestering of most of the anthropogenic contributions of heavy metals within the estuarine environmental compartments is consistent with findings of other studies and suggests that additional efforts now be directed toward determining the potential for back-transport mechanisms from metal-laden sediments which may result even after the toxic effluent treatment schedules are realized. W77-04176

**TERRESTRIAL CONTRIBUTION OF N TO STREAM WATER IN MANAGED AND UNDISTURBED FORESTED WATERSHEDS,**  
New Mexico State Univ., University Park. Dept. of Biology.

J. R. Gosz.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 495, Price codes: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Report No. 082, Technical Completion Report, December 1976, 82 p., 18 fig., 10 tab, 26 ref. OWRT B-053-N Mex(1).

Descriptors: \*Watershed management, \*Nitrogen, \*Soil-water-plant relationships, \*Nitrification, \*Surface runoff, Nitrogen cycle, Soil water movement, forest management, Soil microorganisms, Cutting management, Path of pollutants, Water pollution sources, \*Forest watersheds.

Identifiers: \*Gaged watersheds, \*Sk. area development, Mixed conifer pinon-juniper, Aspen, Spruce-fir communities, Tesoqua watershed.

Studies have been made of inputs and outputs of N from a number of undisturbed and managed watersheds along an elevational gradient. Although N concentrations in stream water vary greatly, N budgets show net losses are similar. Factors which appear responsible for the variation include stream discharge, soil temperature, soil moisture, snow accumulation, precipitation intensity, N in precipitation, stream bed area, plant uptake, nitrification and denitrification. The results suggest that plant uptake and denitrification may cancel much of the effect of differences in nitrate production among the communities studied. (Hain-New Mexico State)  
W77-04178

**BARATARIA BASIN: BIOLOGICAL CHARACTERIZATION,**  
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.  
For primary bibliographic entry see Field 2L.  
W77-04188

**APPLICATION OF ESTIMATION THEORY TO DESIGN OF SAMPLING PROGRAMS FOR VERIFICATION OF COASTAL DISPERSION PREDICTION,**  
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

R. De Guida, J. J. Connor, and B. Pearce. Sea Grant Report No. MITSG-76-16, November 20, 1976. 35 p., 11 fig., 15 ref. MITSG 76-16, SG-04-5-158-1.

Descriptors: \*Sampling, \*Dispersion, \*Pollutants, \*Mathematical models, \*Water pollution sources, \*Monitoring, Coasts, Finite element analysis, Water resources, \*Path of pollutants.

Identifiers: Estimation theory, Kalman-Bucy filtering, Sea Grant Program.

The analytical framework for applying Kalman-Bucy filtering to dispersion in a coastal water body is developed. Particular emphasis is placed on quantification of the model uncertainty due to model parameters, source loadings, and velocity fields. The formulation is discretized with the Finite Element Method, and a number of comparison studies are presented. (NOAA)  
W77-04193

**ATMOSPHERIC TRACE METALS OVER THE NEW YORK BIGHT,**  
National Oceanic and Atmospheric Administration, Boulder, Colo. Marine Ecosystems Analysis Program Office.

R. A. Duce, G. T. Wallace, Jr., and B. J. Ray. NOAA Technical Report ERL 361-MESA 4, April 1976. 21 p., 7 fig., 14 tab, 39 ref.

Descriptors: Surface waters, \*Water pollution sources, \*Metals, New York, Atmosphere, Iron, Aluminum, Zinc, Cadmium, Lead, Sodium, \*Air pollution effects, Trace elements, Path of pollutants.

Identifiers: \*Trace metals, \*New York Bight.

Iron, aluminum, zinc, cadmium, lead, and sodium were determined in a series of near-surface atmospheric particulate samples collected by the R/V WESTWARD from several areas of the New York Bight. The atmospheric concentrations were generally about 10 to 20 percent of the mean concentrations observed over a 2-year period at several locations in New York City. This was not the case for atmospheric sodium whose primary source is the sea. Atmospheric concentrations of the other elements over the bight showed a dependence on distance from the coast and surface wind direction. Rough estimates of atmospheric input to the surface waters of the bight suggest that, of the total input of pollutant material from barge dumping, runoff, sewage, rivers, and atmospheric deposition, up to 13 percent of the lead, 8 percent of the zinc, 5 percent of the iron, and 1 to 2 percent of the cadmium may enter by way of the atmosphere. (NOAA)  
W77-04195

**FIRST DATA ON THE PRESENCE OF SOME METALLIC ELEMENTS IN MYTILUS GALLOPROVINCIALIS, LAM. OF THE EASTERN SICILIAN COAST, REVEALED BY ATOMIC ABSORPTION SPECTROPHOTOMETRY, (IN ITALIAN),**  
Catania Univ. (Italy).  
For primary bibliographic entry see Field 5A.  
W77-04207

**AMMONIA LOSSES ON UREA FERTILIZATION I. MODEL EXPERIMENTS ON AMMONIA VOLATILIZATION AS INFLUENCED BY SOIL PH VALUE, EXCHANGE CAPACITY, TEMPERATURE AND WATER CONTENT, (IN GERMAN),**  
Deutsche Akademie der Landwirtschaftswissenschaften zu Berlin, Leipzig (East Germany). Institut fuer Duengungsforschung.  
For primary bibliographic entry see Field 2G.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

W77-04208

#### ORGANIC CARBON AND NITROGEN CONCENTRATIONS AND ANNUAL ORGANIC CARBON LOAD OF SIX SELECTED RIVERS OF THE UNITED STATES, Geological Survey, Reston, Va. Water Resources Div.

R. L. Malcolm, and W. H. Durum.

Available from Supt. of Documents, GPO, Wash., D.C. 20402, price \$0.45. Water-Supply Paper 1817-F, 1976. 21 p, 1 fig, 5 tab, 21 ref.

Descriptors: \*Water pollution sources, \*Organic matter, \*Carbon, \*Nitrogen, \*Rivers, United States, Suspended load, Solubility, Sediments, Soils, Runoff, \*Path of pollutants.

Identifiers: \*Dissolved organic matter.

The organic carbon load study in six U.S. rivers during 1969-70 show that the 3.7-million-ton and 52-thousand-ton annual organic carbon loads of the Mississippi River and the Brazos River (Tex.), respectively, were approximately equally distributed between dissolved and suspended phases, whereas the 79.8-million-ton organic load of the Missouri River was primarily in the suspended phase. The major portion of the 7.3-thousand-ton and the 21-thousand-ton organic carbon loads of the Sopchoppy River (Fla.) and the Neuse River (N.C.), respectively, was in the dissolved phase. DOC (dissolved organic carbon) concentrations in most rivers were usually less than 8 mg/liter. SOC (suspended organic carbon) concentrations fluctuated markedly with discharge, ranging between 1 and 14 percent, by weight, in sediment of most rivers. DOC concentrations were independent of discharge, whereas SOC and SIC (suspended inorganic carbon) concentrations were positively correlated with discharge. Seasonal fluctuations in DOC and SOC were exhibited by the Missouri, Neuse, Ohio, and Brazos Rivers, but both SOC and DOC concentrations were relatively constant throughout the year in the Mississippi and Sopchoppy Rivers. The carbon-nitrogen ratio in the sediment phase of all river waters averaged less than 8:1 as compared with 12:1 or greater for most soils. The abundance of organic material in the dissolved and suspended phase of river waters in this study indicate a large capacity factor for various types of organic reactivity within all streams and the quantitative importance of organic constituents in relation to the water quality of river and streams. (Woodard-USGS)

W77-04230

#### AN OILSPILL RISK ANALYSIS FOR THE MID-ATLANTIC OUTER CONTINENTAL SHELF LEASE AREA, Geological Survey, Reston, Va. Water Resources Div.

R. A. Smith, J. R. Slack, and R. K. Davis.

Open-file report 76-451, June 1976. 24 p, 9 fig, 3 tab, 4 ref.

Descriptors: \*Water pollution sources, \*Oil spills, Continental shelf, \*Atlantic Ocean, \*Northeast U.S., Oil industry, Forecasting, Path of pollutants, Exploration, Drilling, Oil wastes, Environmental effects, Water pollution control, New Jersey, Delaware, Path of pollutants.

Identifiers: \*Offshore drilling(Oil).

An oilspill risk analysis was conducted to determine relative environmental impacts of developing oil in different regions of the Mid-Atlantic Outer Continental Shelf lease area. The study analyzed probability of spills, likely path of pollutants from spills, and locations in space and time of recreational and biological resources likely to be vulnerable. These results are combined to yield estimates of the overall oilspill risk associated with development of the lease area. (Woodard-USGS)

W77-04232

#### TIME OF TRAVEL OF SOLUTES IN MISSISSIPPI RIVER FROM THE ARKANSAS-LOUISIANA STATE LINE TO PLAQUEMINE, LOUISIANA, Geological Survey, Baton Rouge, La. Water Resources Div.

A. J. Calandro.

Louisiana Department of Public Works, Baton Rouge, Water Resources Technical Report No 12, 1976. 5 p, 7 fig, 5 ref.

Descriptors: \*Water pollution, \*Path of pollutants, \*Mississippi River, \*Louisiana, \*Tracking techniques, Fluorescent dye, Streamflow, Flow rates, Data collections, Mathematical models, Forecasting, Movement, Travel time.

Identifiers: \*Accidental pollutant spills.

Accidental spills of pollutants in a river could be harmful to water users along the river. Planners and downstream water users should have knowledge of the behavior of dissolved pollutants accidentally spilled into the river. A water tracer was injected at three locations into the Mississippi River to determine the traveltimes, the maximum concentration, the dispersion characteristics, and the duration of a tracer cloud for the reach from the Arkansas-Louisiana State line (mile 507) to Plaquemine, La. (mile 208). The flow in the river at Vicksburg, Miss., was approximately 400,000 cubic feet per second during the study. Information from this study and from a previous study was used to calibrate a mathematical model developed at the U.S. Geological Survey's Gulf Coast Hydroscience Center. The model was then used to generate time-of-travel curves of the leading edge, the peak, and the trailing edge of the tracer cloud for discharges ranging from 200,000 to 1,500,000 cubic feet per second. (Woodard-USGS)

W77-04247

ment; (2) leaching studies of the lignite and overburden at Fairfield and Rockdale; (3) precipitation samples collected under the airborne waste plume from the lignite-fueled electric generating plant at Fairfield; and (4) a limited trace element enrichment study in the soils around the plant at Fairfield. Potential lignite reserves include about 41 percent of the outcrop area of the Wilcox Aquifer. Strip mining can change the hydrologic characteristics of the area and full development of the near-surface lignite reserves in east and east central Texas could have a significant impact on the groundwater resources of the region. Approximately 25 percent of the identified near-surface lignite deposits are committed to existing and presently planned lignite-fired power plants in Texas. The development of deep-basin lignite deposits in the near future appears inevitable. Lignite can contain elevated concentrations of certain trace elements and power plants tend to concentrate these elements. When the lignite is fired at the plant some trace metals are concentrated in the fly ash (arsenic, iron, manganese and lead), while others are discharged from the stack primarily as a vapor (mercury and selenium). Improper handling and disposal of fly ash could result in pollution of water supplies.

W77-04249

#### USE OF SALINE WATER IN AGRICULTURE. II. CROP GROWTH AND RESPONSE TO FERTILIZER APPLICATION UNDER SALINE WATER USE IN CULTIVATORS' FIELDS, Central Arid Zone Research Inst., Jodhpur (India). For primary bibliographic entry see Field 3C.

W77-04311

#### HEAVY METAL ACCUMULATION IN ESTUARINE SEDIMENTS IN A HISTORICAL MINING OF CORNWALL, Hong Kong Univ. Dept. of Geography and Geology.

W. W. -S. Yim.

Marine Pollution Bulletin, Vol. 7, No. 8, p. 147-150, August, 1976, 1 tab, 3 fig, 9 ref.

Descriptors: \*Sediments, \*Heavy metals, \*Path of pollutants, \*Cores, \*Mine wastes, \*Sampling, \*Particle size, \*Geomorphology, Estuaries, Lead, Zinc, Copper, Analytical techniques, Deposition(Sediments), Estuaries.

Identifiers: \*Tin.

Sediments in the Hayle estuary in a historical mining area of Cornwall have been found to contain exceptionally high concentrations of tin, arsenic, copper, lead, tungsten, and zinc. In this study, the distribution of these heavy metals is correlated with pollution from past mining activity through mine waste discharge into streams, and changes which took place at the time of the development of the Upton Towns. (Katz)

W77-04329

#### DISTRIBUTION AND ABUNDANCE OF ICHTHYOPLANKTON IN THE NEW YORK BIGHT DURING THE FALL IN 1971, New York Ocean Science Lab., Montauk.

H. H. Austin.

New York Fish and Game Journal, Vol 23, No 1, p. 58-72, January, 1976. 11 fig, 24 ref.

Descriptors: \*Thermal stratification, Environmental effect, \*Fish reproduction, \*Spawning, \*Fish migration, \*Juvenile growth stage, \*Water quality control, \*Commercial fish, \*Fish eggs, \*Fish populations, Phytoplankton, Sampling, Larvae, Salinity, Temperature, Perches, New York.

Identifiers: \*New York Bight, Menhaden, Anchovy, Hake, Weakfish, Tautoga, Butterfish, Searobin, Flounder, Brevoortia sp, Anchoa sp, Merluccius sp, Cynoscion sp, Tautoga sp, Peprilus sp.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

Sampling for phytoplankton, zooplankton, water chemistry and physical parameters was conducted at a series of stations in the New York Bight in September and November of 1971. The relationships of the finfish eggs and larvae collected to the associated oceanographic conditions are discussed in terms of the sources of the parent stocks and the time and place of spawning. The bulk of the spawning that occurs in coastal New York waters is by migratory stocks, the principal species in the New York Bight being the menhaden, anchovy, weakfish, mackerel and searobin. (Katz) W77-04333

**TEST OF A MODEL FOR PREDICTING THE BODY BURDEN OF TRACE CONTAMINANTS IN AQUATIC CONSUMERS,**  
Oak Ridge National Lab., Tenn. Environmental Sciences Div.  
For primary bibliographic entry see Field 5C.  
W77-04341

**GRAZING AND DEBRIS BURNING ON PINYON-JUNIPER SITES—SOME CHEMICAL WATER QUALITY IMPLICATIONS,**  
Utah Center for Water Resources Research, Logan; and Utah State Univ., Logan. Dept. of Range Service.  
J. C. Buckhouse, and G. F. Gifford.  
Journal of Range Management, Vol 29, No 4, July 1976, p 299 - 301. 4 fig, 4 ref. OWRT A-022-UTAH(5), 14-34-0001-6046.

Descriptors: \*Debris, \*Pinyon pine trees, Juniper trees, \*Grazing, Water quality, \*Burning, \*Utah, Water pollution sources, Potassium, Phosphorus. Identifiers: San Juan County(Utah), Southeastern Utah.

During 1973 and 1974, a water quality study was conducted in San Juan County, southeastern Utah. Water quality data were collected from the study location which had been chained to remove pinyon-juniper vegetation six years earlier. Debris burning and livestock grazing treatments were studied. An 'undisturbed, natural' woodland was left adjacent to the treatments in order to serve as control areas. Following burning, significant increases in potassium and phosphorus were observed in overland flow from infiltration plots. No significant treatment changes were detected for sodium, calcium, or nitrate-nitrogen. No treatment differences due to grazing were detected at the soil surface following cattle use (stocking rate was 2 ha/AUM).  
W77-04392

**RURAL ROAD SYSTEMS AS A SOURCE OF SEDIMENT POLLUTION - A CASE STUDY,**  
North Carolina State Univ., Raleigh. Dept. of Forestry.  
W. L. Hafley.

Paper presented and published in Proceedings of a Symposium Conducted by the Irrigation and Drainage Div. of American Society of Civil Engrs., Logan, Utah, Aug. 11-13, 1975, p. 393-405. 5 fig, 1 tab. OWRT B-094-NC(3), 14-34-0001-6107.

Descriptors: \*Sediments, \*Sediment yields, \*Sediment loads, \*Erosion rates, \*Roadbanks, Highways, Highways effects, Roads, Drainage ditches, Embankments, \*North Carolina, Watershed management. Identifiers: \*Rural roads, Unpaved roads, Filter strips, Durham(NC).

A recent study of the effects of land use on a 168 square mile municipal watershed, provided the opportunity to examine, in a preliminary way, the role of the rural road system as a source of sediment pollution of the streams of the basin and the storage impoundment they fed. A summary is presented of the observations and measurements made on the rural road system as a small part of the investigation of the effect of land use changes

on the quality, quantity and timing of water yield from the drainage basin. (Stewart-NC State) W77-04394

**THE USE OF REMOTE SENSING FOR COASTAL ZONE MONITORING,**  
Texas A and M Univ., College Station. Remote Sensing Center.  
A. R. Benton, Jr.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 157-170, 11 ref.

Descriptors: \*Remote sensing, \*Monitoring, Water resources, \*Water pollution sources, \*Resources development, \*Baseline studies, Aerial photography, Satellites(Artificial).

Identifiers: Coastal zone management.

The cartographic portrayal, on a satisfactory base map, of an accumulation of related parametric data of reasonable accuracy, acquired over not too long a period of time, is called a 'baseline map'. The baseline map becomes the standard against which any subsequent changes in those parameters are to be measured. Monitoring, in this sense, is the periodic gathering of new data for purposes of comparison with the baseline information in order that changes and trends may be documented. Every effort should be made to continually update baseline maps thus maintaining their relevance. A camera, used with appropriate film and filter combinations, will provide mapping or monitoring data on most of the parameters of interest to the coastal zone manager. The sensors discussed in this paper are those which can be taken aboard an aircraft. Satellite-borne systems are an alternate monitoring methodology. With respect to coastal zone monitoring use, the appropriate satellite is LANDSAT-1 with its multispectral scanner. Satellite monitoring should be considered first because it is less expensive for the user than aerial photography. Within the framework of satellite monitoring, the only viable system options would seem to be film positives and tape manipulation. The tape manipulation option adds a capability which increases the likelihood of image identification and differentiation. (See also W77-04462) (Sinha-OEIS)  
W77-04475

**THERMAL POLLUTION IN THE LOS ANGELES-LONG BEACH HARBOR: CONSEQUENCES AND ALTERNATIVES,**  
University of Southern California, Los Angeles. Allan Hancock Foundation.

G. D. Brewer.  
In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November, 1975. p. 171-176, 16 ref.

Descriptors: \*California, \*Water pollution sources, \*Thermal pollution, \*Environmental effects, \*Resources development, Coasts, Plankton, Powerplants, Harbors, Heated water.

Identifiers: Coastal zone management.

The proposed discharge of heated and chilled sea water from an electric power generating plant and a liquified natural gas (LNG) vaporization plant respectively, into the Los Angeles-Long Beach Harbor raises questions about the effects of these effluents on the harbor's unique biotic resources. This paper discusses aspects of the entrainment of planktonic organisms through these 'once through' heat exchange systems and the implications of sustained temperature alterations of the harbor's receiving waters. Alternatives to the proposed discharge of these potentially damaging thermal effluents are discussed. (See also W77-04462) (Sinha-OEIS)  
W77-04476

**A RISK AND COST ANALYSIS OF TRANSPORTING SOUTHERN CALIFORNIA OUTER CONTINENTAL SHELF OIL.**  
Booz-Allen and Hamilton Inc., Bethesda, Md. For primary bibliographic entry see Field 5G.  
W77-04490

**THE SURVIVAL OF SEWAGE BACTERIA AT VARIOUS OCEAN DEPTHS,**  
Civil Engineering Lab. (Navy), Port Hueneme, Calif.

H. P. Vind, J. S. Muraoka, and C. W. Mathews. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A017 700, Price codes: A02 in paper copy, A01 in microfiche. Final Report No. TN-1396, July 1975. 25 p, 13 fig, 2 tab, 10 ref.

Descriptors: \*Continental Shelf, \*Bacteria, \*Sewage bacteria, \*Waste disposal, \*Domestic wastes, \*Water pollution sources, \*Environmental effects, Pollutants, Salinity, Depth, Coliforms, California, \*E. coli.

Identifiers: \*Outer Continental Shelf, Escherichia coli, \*Ocean outfalls, Human wastes.

Sewage outfalls in the ocean are usually relatively close to shore at depths of 200 feet or less. An investigation was undertaken to ascertain if Escherichia coli, the principal species of bacteria in sewage, would survive for shorter or longer periods if the sewage were discharged at depths of 1,000 feet or so, where there is no light, and where the pressure is greater and the temperature is lower. Cultures of the Seattle strain of E. coli in autoclaved seawater were placed in 25-ml bags made of dialyzing tubing. Some of the bags were suspended near the surface of the ocean, some at depths of 200 and some at depths of 1,000 feet. It was found that if the sewage were discharged at a depth of 1,000 feet, there would be no danger of contaminating surface waters because the cold deep water does not mix with the warmer surface waters; if the sewage were discharged at a depth of 200 feet, there would probably also be no danger of contaminating surface waters unless the thermocline was deeper than that; if the sewage were discharged at shallow depths, there would be contamination of surface waters, but at least one species of the contaminating microorganisms would probably survive for only a few hours in sunlight. (Sinha-OEIS)  
W77-04491

**A COST-EFFECTIVE SATELLITE-AIRCRAFT-DROGUE APPROACH FOR STUDYING ESTUARINE CIRCULATION AND SHELF WASTE DISPERSION,**  
Delaware Univ., Newark. Coll. of Marine Studies. V. Klemas, G. Davis, H. Wang, W. Whelan, and G. Tornatore.

Available from the National Technical Information Service, Springfield, VA 22161 as N76-16528, Price codes: A02 in paper copy, A01 in microfiche. Reprint from Ocean '75, MTS and IEEE Combined Conference, p 751-760, 1975. Also as Delaware University College of Marine Studies Report No. CMS-NASA-5-75. 11 fig, 11 ref.

Descriptors: \*Continental Shelf, \*Remote sensing, \*Waste disposal, \*Water pollution sources, \*Oil pollution, Dispersion, Ocean currents, Ocean circulation, Cost benefit analysis, Resources development, Environmental effects, Delaware Bay, Atlantic Ocean. Identifiers: \*Outer Continental Shelf, \*Estuarine circulation, U.S. East Coast.

The mounting economic pressure to extract oil and other resources from the Continental Shelf and to continue using it for waste disposal is creating a need for cost-effective, synoptic means of determining currents in this area. An integrated satellite-aircraft-drogue approach has been developed which employs remotely tracked expendable drogues together with satellite observations of

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

waste plumes and natural tracers, such as suspended sediment. Tests conducted on the Continental Shelf and in Delaware Bay indicate that the system provides a cost-effective means of monitoring current circulation and ocean waste dispersion even under severe environmental conditions. (Sinha-OEIS)  
W77-04492

#### ENVIRONMENTAL TOXICITY OF AQUATIC RADIONUCLIDES: MODELS AND MECHANISMS.

Rochester Univ., N.Y.  
For primary bibliographic entry see Field 5C.  
W77-04508

#### EFFECTS OF RADIATION ON AQUATIC POPULATIONS,

Battelle-Pacific Northwest Labs., Richland, Wash.  
For primary bibliographic entry see Field 5C.  
W77-04509

#### THE DISTRIBUTION OF TRANSURANIC ELEMENTS IN A FRESHWATER POND ECOSYSTEM,

Battelle Pacific Northwest Lab., Richland, Wash.  
Ecosystems Dept.

For primary bibliographic entry see Field 5C.  
W77-04510

#### RADIOCESIUM TRANSPORT IN THE HUDSON RIVER ESTUARY,

New York University Medical Center, N.Y. Inst. of Environmental Medicine.

S. M. Jinks, and M. E. Wrenn.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 207-227, 5 fig, 3 tab, 16 ref.

Descriptors: \*Model studies, \*Environmental effects, \*Radioisotopes, \*Cesium, Sediments, Freshwater, Salinity, Fish, \*Hudson River, \*Path of pollutants, Estuaries.

Radiocesium data obtained in the Hudson River Estuary were used to evaluate the distribution, rates of transfer, and the mechanisms of radionuclide transfer between water and sediment. The percentage of Cs137 and Cs134 present in the dissolved state at Indian Point was found to vary as a function of water salinity with less than 20% of the total radiocesium being dissolved in fresh water and over 90% being in the dissolved state when chlorine concentrations exceeded 2.0 g/l. Desorption during intrusion of saline water appears to be the primary mechanism for the removal of radiocesium from bottom sediment at the site. Models were constructed for the estimation of monthly average concentrations and compared with observed concentrations of radiocesium in fish. (See also W77-04508) (Chilton-ORNL)  
W77-04512

#### PLUTONIUM-237 AND -246: THEIR PRODUCTION AND USE AS GAMMA TRACERS IN RESEARCH ON PLUTONIUM KINETICS IN AN AQUATIC CONSUMER,

Oak Ridge National Lab., Tenn. Environmental Science Div.

For primary bibliographic entry see Field 5C.  
W77-04513

#### THE COLLOIDAL NATURE OF RADIONUCLIDES IN SEAWATER,

Rochester Univ., N.Y. Dept. of Radiation Biology; and Rochester Univ., N.Y. Dept. of Biophysics.

I. Feldman.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms,

Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 183-190, 35 ref.

Descriptors: \*Radioactivity techniques, \*Radioisotopes, Seawater, \*Colloids, Chemistry, Radium, Thorium, Uranium.

The subject of radiocolloid formation and its significance in seawater are reviewed. Data indicates that the Ra226/Th230/U relationship in seawater can be explained from the fact that the tendencies of these elements to form radiocolloids in seawater decreases in the following order: thorium-radium-uranium. (See also W77-04508) (Chilton-ORNL)  
W77-04514

#### MEASUREMENTS FOR MODELING RADIONUCLIDE TRANSFER IN THE AQUATIC ENVIRONMENT,

Georgia Inst. of Tech. Atlanta. Environmental Resources Center.

B. Kahn.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 165-181, 1 tab, 31 ref.

Descriptors: \*Analytical techniques, \*Radioisotopes, Aquatic environment, Measurement, Instrumentation, Freshwater, Seawater, Fish, Radiochemical analysis, Biota, Nuclear powerplants, Pollution identification.

The more commonly applied analytical methods are reviewed for measuring radionuclides in the environment and indicates some of the problems involved, particularly as encountered in studies at nuclear power stations. Radionuclides are considered with regard to the efforts required for concentration, chemical separation, and instrumental measurement in samples of both fresh and sea water, fish and shellfish, algae, plankton, seaweed, and sediment. The most effective means for measuring radionuclides that emit gamma rays is identified as a Ge(lil) detector plus a multichannel analyzer calibrated for counting efficiency and energy. Radiochemical separations are necessary for all radionuclides that emit gamma rays or whose gamma rays cannot be detected in the sample because they were obscured by others or are below the detection limit. After obtaining the radionuclide in soluble form, the conventional radiochemical processes are applied. Simultaneous occurrence of radionuclides in several chemical and physical forms is a major topic of discussion. (See also W77-04508) (Chilton-ORNL)  
W77-04515

#### A SYSTEMS ANALYSIS MODEL FOR CALCULATING RADIONUCLIDE TRANSPORT BETWEEN RECEIVING WATERS AND BOTTOM SEDIMENTS,

Oak Ridge National Lab., Tenn. Environmental Sciences Div.

R. S. Booth.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 133-164, 5 tab, 2 fig, 44 ref.

Descriptors: \*Model studies, \*Environmental effects, \*Radioisotopes, Sediments, Sotion, \*Systems analysis, \*Bottom sediments.

The model reported upon has four variables: the receiving water, interstitial water intermingled with the bottom sediments, bottom sediment particles that undergo sorption-desorption reactions with the interstitial water, and bottom sediment particles that undergo only sorption reactions with the interstitial water. From the model two tables were generated; one of these gives equilibrium

radionuclide concentrations in the receiving water when radionuclide transfers to bottom sediments are possible, divided by the receiving water concentrations when transfers to bottom sediments are ignored; the other lists ratios of equilibrium radionuclide concentrations in sediments, divided by their corresponding receiving water concentrations. Results indicated that the usual effect of a neglect of sediment interactions is an overestimate of the total potential dose to man from the radionuclides. (See also W77-04508) (Chilton-ORNL)  
W77-04516

#### AMERICIUM IN THE MARINE ENVIRONMENT-RELATIONSHIPS TO PLUTONIUM,

Woods Hole Oceanographic Institution, Mass.

For primary bibliographic entry see Field 5C.

W77-04517

#### THE BEHAVIOR OF PLUTONIUM IN AQUATIC ECOSYSTEMS: A SUMMARY OF STUDIES ON THE GREAT LAKES,

Argonne National Lab. III. Radiological and Environmental Research Div.

For primary bibliographic entry see Field 5C.

W77-04519

#### PLUTONIUM FOODCHAINS,

Helsinki Univ., Finland. Dept. of Radiochemistry.

For primary bibliographic entry see Field 5C.

W77-04520

#### TOWARD A GLOBAL MONITORING PROGRAM FOR TRANSURANICS AND OTHER MARINE POLLUTANTS,

Scripps Institution of Oceanography, La Jolla, Calif.

For primary bibliographic entry see Field 5C.

W77-04522

#### AN EXAMINATION OF THE POSSIBLE EFFECTS OF SUDSBURY NICKEL MINING AND SMELTING OPERATIONS ON FISHES AND THE WATER CHEMISTRY OF LAKES WITHIN THE WHITEFISH LAKE INDIAN RESERVE,

Fisheries and Marine Service, Nanaimo (British Columbia). Biological Station.

For primary bibliographic entry see Field 5C.

W77-04571

#### LEVELS OF ARSENIC AND SELENIUM IN THE GREAT LAKES REGION,

Canada Centre for Inland Waters, Burlington (Ontario).

W. J. Traversy, P. D. Goulen, Y. M. Sheikh, and J. R. Leacock.

Scientific Series No. 58, 1975. 23 p. 8 fig, 17 tab, 29 ref.

Descriptors: \*Toxins, Great Lakes, \*Baseline studies, \*Canada, \*Great Lakes region, Rivers, Precipitation(Atmospheric), Bottom sediments, Fish, Lake Superior, Lake Huron, Lake Erie, Lake Ontario, St. Lawrence River, Toxicity, Chemicals, Surface waters, Pollutant identification.

Identifiers: \*Arsenic, \*Selenium, Georgian Bay(Ontario), St. Mary's River(Ontario).

Lake and river water, precipitation, sediments and fish were sampled for arsenic and selenium at various Great Lakes locations, to assess present levels and establish a future reference baseline. Samples were taken in Lakes Superior, Huron, Erie, Ontario, Georgian Bay, various rivers as well as the St. Marys and St. Lawrence. Fish were sampled in Lakes Erie and Ontario. Arsenic and Selenium levels in the waters of the Ontario region were in the ranges of <0.1-1.40 microgram/l and <0.1-0.80 microgram/l, respectively. Selenium levels were about the same as elsewhere in the world but ar-

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senic levels were comparatively lower. In precipitation samples, arsenic was in the range of <0.1-2.50 microgram/l and selenium about <0.1-1.00 microgram/l, indicating that precipitation may be a significant source of these two toxins. High concentrations of precipitation were generally found near industrial locations. Arsenic and selenium levels in sediment were in the ranges of 0.5-14.0 microgram/g and 0.2-2.0 microgram/g, respectively. Fish samples showed ranges of 0.03-0.12 microgram/g for arsenic and 0.01-0.08 microgram/g for selenium. There was no apparent biomagnification of either element from sediments to fish. Concentrations did not exceed the Canadian drinking water standards in any potable waters. (Auen-Wisconsin)  
W77-04574

**OBSERVATIONS ON THE PROBLEMS OF POLLUTION IN SHATT AL-ARAB, IRAQ,**  
Alexandria Univ. (Egypt). Dept. of Oceanography.  
M. A. H. Saad.  
Revue Internationale d'Oceanographie Medicale,  
Vol 18, p 3-11, 1976. 2 fig, 1 tab, 12 ref.

Descriptors: \*Rivers, \*Water pollution effects, \*Water pollution sources, \*Foreign countries, \*Oil pollution, Pollutants, Sewage effluents, Tributaries, Decomposing organic matter, Dissolved oxygen, Industrial wastes, Pesticides, Agricultural runoff, Fertilizers, Oil spills, Oil wastes, Oily water.

Identifiers: \*Shatt al-Arab(Iraq and Iran), Basra(Iraq), Persian Gulf, Iraq, Iran.

Shatt-Al-Arab, the confluence of the Tigris and Euphrates Rivers in southern Iraq and along the border with Iran, carries 35,300 million cubic meters of water annually into the Persian gulf and is the Gulf's major pollution source. Oil and oily wastes from hundreds of tankers entering the Shatt for unloading are the major pollution source, but untreated sewage fed into the confluence from the Iraq city of Basra have covered the bottom with sludge beds, markedly eutrophied the waters, caused bacterial contamination in the aquatic environment, and created a public health danger. Organic matter decomposition is accelerated by the river's water temperatures, which reach 12.8, 21.0, 27.8 and 24.8 centigrade in winter, spring, summer and autumn, respectively. In addition, the sewage-introduced bacteria in decomposition reduces dissolved oxygen to levels ranging from 3.2 to 1.3 mg/l, with resultant fishkills. Other pollutants entering Shatt al-Arab directly and through its tributaries are untreated industrial wastes, pesticides and fertilizers. Increasing industrialization and population growth are compounding pollution problems in the Shatt. (Auen-Wisconsin)  
W77-04575

**BACTERIAL DEGRADATION OF MOTOR OIL,**  
Maryland Univ., College Park. Dept. of Microbiology.  
J. D. Walker, R. R. Colwell, and L. Petrakis.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A016 328, Price codes: A02 in paper copy, A01 in microfiche. Technical Report 1972-74, October 1975. 10 p, 4 fig, 3 tab, 12 ref. N00014-67-A-0239-0027.

Descriptors: \*Biodegradation, \*Oil, \*Microbial degradation, \*Oil spills, Waste treatment, Sewage effluents, Chesapeake Bay, Maryland, Oil wastes, Oil pollution, Degradation(Decomposition).  
Identifiers: \*Motor oil(Degradation).

In a study to determine the potential of naturally-occurring marine microbes to break down hydrocarbons in coastal oil spills through bacterial action, two stations in Chesapeake Bay were sampled to obtain microorganisms. Water column microorganisms worked better than those from sediments in degrading oil. Normal alkanes were most readily susceptible to degradation. The per-

centage of saturated hydrocarbons remaining after biodegradation was smaller for those microorganisms cultured in an oil salts medium. Biodegradation of saturated hydrocarbons by microorganisms cultured in the oil salts medium supplemented with nitrate and phosphate was greater for those cultures derived from sediment samples; the converse was true for microorganisms cultured in Chesapeake Bay water. A similar trend was observed for degradation of aromatic hydrocarbons. The results indicate that microorganisms isolated from an oil-contaminated environment may be inoculated into water collected from an uncontaminated source to promote biodegradation of oil. (Auen-Wisconsin)  
W77-04577

**COMPUTER PROGRAM FOR PRESENTING ACTUAL LAKE DATA, (IN GERMAN),**  
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).  
For primary bibliographic entry see Field 7C.  
W77-04585

**DISCHARGE OF TREATED WASTEWATER IN LAKES, (IN GERMAN),**  
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).  
H. Buehrer, and H. Ambuehl.  
Schweiz Z Hydrol 37(2), p 347-369, 1975.

Descriptors: \*Thermal pollution, \*Heated water, \*Lakes, \*Waste water(Pollution), Waste disposal.  
Identifiers: \*Trophicogenic layer(Lakes).

Treated wastewater discharged into a lake should be introduced below the trophogenic layer. Tracing the marked wastewater by echosounding revealed that the usual discharge method is unsuitable. The wastewater flows more or less to the depth of its own density, which is usually in the trophogenic layer. If there is no movement (current) in the water body, the wastewater accumulates at the pipe's mouth. A continuous current is an indispensable prerequisite for a wastewater discharge site. Only when wastewater is mixed with at least 5 parts of lake water does it not rise more than 20 m.—Copyright 1976, Biological Abstracts, Inc.  
W77-04595

**PROGNOSIS OF PESTICIDE STABILITY IN WATER, SOIL AND PLANTS, (IN RUSSIAN),**  
Kievskii Meditsinskii Institut (USSR).  
E. I. Goncharuk, V. I. Tsipriyan, K. S. Stefanskii, and V. M. Pereylin.  
Gig Sanit 10, p 18-22, 1975.

Descriptors: \*Pesticides, \*Pesticide residues, \*Biodegradation, Soils, DDT, Vegetables, Apples, Carrots, Insecticides, Potatoes, Forecasting.  
Identifiers: Cabbage, Campheine, Dilor, Lindane, Pineine.

To investigate the hazard of environmental pesticide accumulation, a method of assessing their stability estimates the period of their complete degradation. The investigated pesticides were least stable in vegetables (potatoes, carrots, cabbage, apples) and most stable in soil. The pesticides tested were, in order of diminishing stability, DDT, polychloropropene, polychlorocamphene, Lindane and dilor.—Copyright 1976, Biological Abstracts, Inc.  
W77-04600

### 5C. Effects Of Pollution

**INVESTIGATION TO DETERMINE EXTENT AND NATURE OF NON-POINT SOURCE ENRICHMENT AND HYDROLOGY OF SEVERAL**

**RECREATIONAL LAKES OF EASTERN WASHINGTON, (PART I AND PART II),**  
Washington State Univ. Pullman. Dept. of Civil and Environmental Engineering.  
For primary bibliographic entry see Field 5B.  
W77-04103

**HERBICIDE MOVEMENT WITH WATER AND EFFECTS OF CONTAMINANT LEVELS ON NON-TARGET ORGANISMS,**  
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Plant Pathology and Physiology.  
For primary bibliographic entry see Field 5B.  
W77-04104

**EFFECTS OF HIGH LEVELS OF INORGANIC PHOSPHATE ON AQUATIC ORGANISMS IN PHOSPHATE-RICH ENVIRONMENTS,**  
Georgia Inst. of Tech., Atlanta. School of Biology. J. R. Strange.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 290, Price codes: A06 in paper copy, A01 in microfiche. Georgia Environmental Resources Center, Atlanta, Report No. ERC-1076, October, 1976, 110 p, 9 fig, 18 tab, 35 ref., 8 append. OWRT B-088-GA(2), 14-31-0001-4071.

Descriptors: Eutrophication, \*Channel catfish, \*Daphnia, \*Phosphates, \*Georgia, Lakes, Water pollution effects, \*Monitoring, \*Metabolism, Bioassay, Analytical techniques, Sulfates, Enzymes, Water analysis.

Identifiers: Cardiac rate, Metabolic aberrations, \*Lake Lanier(Geo).

During the course of this three-year study (1973-1976) on Lake Lanier, the water quality in the Flat Creek Embayment did not change appreciably. Water quality is somewhat better than it was five years ago. Bacteriological evaluation of the Flat Creek water revealed larger numbers of coliforms present in 1975 than in 1973. A process for monitoring cardiac and opercular rates in the channel catfish was developed utilizing unimplanted electrodes. Cardiac rates increased with increasing phosphate levels up to 15-20 mg/l. No further increases were observed at levels up to 160 mg/l. Chronic exposure at 20 mg/l phosphate revealed no accommodation to the phosphate-induced cardiac rate elevation. A technique developed for monitoring basal metabolic function demonstrated increased metabolic rates in the channel catfish with increasing phosphate levels up to concentrations of 10 to 15 mg/l. In a food conversion efficiency study, catfish exposed to 10 mg/l phosphate grew faster than controls. Fish exposed to 20 mg/l fell between the controls and the 10 mg/l group. Although the phosphate-exposed fish grew faster and ate more, their food conversion efficiencies were similar to controls. Biochemical studies in which the activities of the enzymes lactate dehydrogenase (LDH), pyruvate kinase (PyK), and hexokinase (HK) were monitored after exposure to phosphate and sulfate gave varied results. It was suggested that phosphate increases the activities of LDH and HK while decreasing the activity of PyK. Sulfate had no effect on these enzyme systems. Attempts at electrophoretic separation of the LDH isozymes met with moderate success. Two major and two minor bands were found to be present using cellulose acetate strips. Starch gel separation proved inadequate. Direct labelling with P-32 phosphate showed incorporation of phosphate in Daphnia and channel catfish. Peak activity was detected in the Daphnia by 2 hours of exposure with no further increases up to 48 hours exposure. Most catfish tissues continued to incorporate additional phosphate throughout the 2-week test period. Catfish fed exclusively P-32 labelled Daphnia showed different phosphate incorporation ratios than those fish exposed directly to the radiolabel. The liver tended to sequester proportionally larger amounts of P-32 in the Daphnia fed experiment than in the direct exposure experiment.

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## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

W77-04105

**ALGAE ABSTRACTS, A GUIDE TO THE LITERATURE, VOLUME 3, 1972-1974.**  
Office of Water Research and Technology, Washington, D.C. Water Resources Scientific Information Center. IFI/Plenum, New York, 1976, 890 p. \$75.00.

**Descriptors:** \*Algae, \*Bibliographies, \*Eutrophication, \*Abstracts, Algal control, Analytical techniques, Bioassay, Biodegradation, Cyanophyta, Nutrients, Lakes, Nitrogen, Phosphorus, Phytoplankton, Sewage, Water pollution effects, Waste water treatment, Documentation, Indexing.

Algae Abstracts is the first in a series of bibliographies on water resources and pollution published by IFI/Plenum Data Corporation in cooperation with the Water Resources Scientific Information Center (WRSIC). It is produced wholly from the information base comprising material abstracted and indexed for Selected Water Resources Abstracts. The bibliography is divided into volumes according to the publication dates of the source documents. Volume 1 contains 569 abstracts covering publication dates up to and including 1969; Volume 2 contains 730 abstracts covering the years 1970 to 1972 (see W74-00704); Volume 3 contains 950 abstracts covering the years 1972 to 1974. The material included in this bibliography represents computer selections based on the presence of a form of the word 'alga' somewhere in the referenced citation. Substantively, the material typifies WRSIC's centers of competence approach to information support of the Office of Water Research and Technology (OWRT) of the Department of the Interior. Most of the references in this bibliography are the work of the center of competence on eutrophication at the University of Wisconsin.

W77-04111

**THE IMPACT OF INTENSIVE APPLICATION OF PESTICIDES AND FERTILIZERS ON UNDERGROUND WATER RECHARGE AREAS WHICH MAY CONTRIBUTE TO DRINKING WATER SUPPLIES. A PRELIMINARY REVIEW,**  
Environmental Protection Agency, Washington, D. C. Office of Toxic Substances. For primary bibliographic entry see Field 5B.

W77-04128

**MUTUAL EFFECT OF ZOOFLAGELLATES, ALGAE AND BACTERIA, (IN RUSSIAN),**  
Akademiya Nauk SSSR, Moscow. Institut Biologii Vnitrennykh Vod. B. F. Zhukov, I. M. Balonov, and S. N. Yagodka. Gidrobiol Zh 11(4), p 88-93, 1975.

**Descriptors:** \*Algae, \*Bacteria, \*Trophic level, Food chains, Water pollution effects.  
**Identifiers:** \*Flagellates, Melosira-islandica, Oscillatoria-agardhii, Pleuromonas-jaculans, \*Zooplankton.

An analysis was made of the mutual effect of flagellates and relatively large algae which cannot serve as food for them. Cultures of the zooflagellate Pleuromonas jaculans and algae Oscillatoria agardhii and Melosira islandica with concomitant bacteria were used. The zooflagellates retarded the development of the algae, but the presence of algae stimulated the development of the zooflagellates. The trophic interrelations of algae and zooflagellates are diverse and play a definite role in the formation and development of aquatic biocenoses.—Copyright 1976, Biological Abstracts, Inc.

W77-04137

### EFFECTS OF THERMAL POLLUTION ON CERTAIN AQUATIC INVERTEBRATES, Clemson Univ., S. C. Dept. of Zoology.

A. S. Tombes, and B. R. Ingram.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 488, Price codes: A04 for paper copy, A01 in microfiche. South Carolina Water Resources Research Institute, Clemson, Report No. 65, August 1976. 57 p., 13 fig., 7 tab, 17 ref. OWRT A-027-SC(2).

**Descriptors:** Ecology, \*Heated water, \*Benthos, Nuclear reactors, Diptera, \*Thermal pollution, Invertebrates, \*South Carolina, Lakes, Water pollution effects, Cytological studies, Water temperature.

**Identifiers:** Frontal ganglion, \*Chaoborus punctipennis, \*Lake Keowee(SC), ULtrastructural data.

Ecological and ultrastructural data are presented on selected macroinvertebrates from Lake Keowee which receives heated effluent from three nuclear reactors. The ecological data show the effects of depth, station, location and season on density, diversity and taxonomic composition of the collected benthos. Abundance and diversity of invertebrates were lower at the discharge canal and its surrounding areas than in the intake canal and control areas. Composition of the substrate and temperature of the environment have decided influences on the fauna of this relatively young lake. The subtle biological effects of a temperature change were determined by examining ultrastructurally the nerve cells of the frontal ganglion in Chaoborus punctipennis. There was a change in the density of nuclear pores and size of the endoplasmic reticulum cisternae in animals exposed to 30°C for three hours and only a change in nuclear pore density in insects held at 25°C for the same time period.

W77-04144

### FIRST REPORT ON THE LIMNOLOGY OF THE ALPINE LAKE LA CALDERA, IN THE PENIBITIC MOUNTAINS (SIERRA NEVADA, GRANADA, SPAIN),

R. Martinez-Silvestre.

Verhandlungen Internationale Vereinigung Limnologie, Vol. 19, Part II, p. 1133-1139, 1975. 4 fig., 7 tab., 8 ref.

**Descriptors:** \*Lake morphology, \*Limnology, \*Oligotrophy, Water properties, Water quality, Lakes, Foreign countries, Europe, Cyanophyta, Chrysophyta, Primary productivity, Phytoplankton, Surveys, Chemical properties, Eutrophication.

**Identifiers:** \*Lake La Caldera(Spain), Alpine lakes, Mountain lakes.

Initial limnological data are given for a small high-mountain lake of glacial origin and very oligotrophic characteristics; the first report presents some of the main water chemical, geological and other characteristics, along with a list of the most important phytoplankton species. Some average chlorophyll-a and primary productivity values are also listed, and the lake's climate and bathymetry are described. Water in La Caldera is very transparent, with Secchi disk visibility always total to the maximum 11.3 meter depth. Acidity during sampling ranged from 7.2-7.4 and temperature from 2-13.5 degrees centigrade. Water chemical composition included no detectable nitrite or chloride and extremely low phosphate concentrations. Nitrate concentrations ranged from 4.5-11.1 micrograms, and reactive silicate values ranged from 7.5-11.3 micrograms. Primary productivity ranged from 0.2-19 mg C cubic meters per hour. The phytoplankton community consists mainly of Chrysophyta, represented by four most-abundant species, and the Cyanophyta Cyanarucus hamiformis, whose growth occurs at the same time that nitrate concentration decreases. Phytoplankton cell numbers are always rather low in La Caldera, and the cells are small—to be ex-

pected from the oligotrophic status of the lake. (Harris-Wisconsin)  
W77-04150

### AN IMPROVED MEMBRANE FILTER METHOD FOR THE ENUMERATION OF PHYTOPLANKTON,

For primary bibliographic entry see Field 5A.

W77-04151

### THE SIGNIFICANCE OF ALKALINE PHOSPHATASE IN A EUTROPHIC LAKE,

R. T. Heath, and G. D. Cooke.

Verhandlungen Internationale Vereinigung Limnologie, Vol. 19, Part II, p. 959-965, 1975. 3 fig., 2 tab., 6 ref. EPA HCS-16010 (R801936).

**Descriptors:** \*Eutrophication, \*Cycling nutrients, Phosphorus, Cyanophyta, Enzymes, Phytoplankton, Surface waters, \*Ohio, Lakes, \*Phosphates, Phosphorus compounds.

**Identifiers:** \*Phosphatase, \*Phosphomonoesters, \*East Twin Lake(Ohio), Aphanizomenon flos-aquae, \*Alkaline phosphatase.

Observations of high alkaline phosphatase activities and phosphomonoesters in East Twin Lake, a small, dimictic, eutrophic lake in northeastern Ohio, lead to the conclusion that the production of alkaline phosphatase by phytoplankton in phosphorus-deficient lakewater may serve as a significant means of providing additional phosphorus to the population. The significance of this enzymatic activity is strictly dependent on the simultaneous occurrence of phosphomonoester substrates in the lakewater. The simultaneous natural occurrence of PME and of alkaline phosphatase apparently produced adaptively by a blooming blue-green algae under conditions of low orthophosphate and low external loading to the lake—along with the apparent relationship between the appearance of the phosphatase and the increase in the size of the algal populations—suggest that this recycling process is related to the provision of the additional phosphorus. Enzyme activity was associated with the major bloom species Aphanizomenon flos-aquae in 1972 and 1973. During both seasons the size of the standing algal crop and the potential productivity of the surface waters increased following the appearance of alkaline phosphatase activity; external loading was low during these growing seasons. (Harris-Wisconsin)

W77-04152

### PROCEEDINGS: BIOSTIMULATION AND NUTRIENT ASSESSMENT WORKSHOP.

Pacific Northwest Environmental Research Lab., Corvallis, Ore.

EPA Ecological Research Series, Report No. EPA-660/3-75-034, June 1975. 321 p.

**Descriptors:** \*Bioassay, \*Eutrophication, \*Trophic level, Biodegradation, Soils, Methodology, Mass transfer, Algae, Growth rates, Nutrients, Mathematical models, Zinc, Heavy metals, Toxins, Surveys, Streams, Cycling nutrients, Mine wastes, Sewage effluents, Specific conductivity, Limiting factors, Algal toxins, Plant growth substances, Waste treatment, Algal control, Marine algae, Estuaries, Photosynthesis, Cyanophyta, Anabaena, Nutrient requirements, Essential nutrients.

**Identifiers:** \*Algal growth potential, \*Algal Assay Procedure Bottle Test, \*Biostimulation, Algal assays, Adenosine triphosphate.

Contributions to this workshop discuss algal assay procedures and their applications in determining the trophic level of lakes and rivers, as well as algal inhibitors. Research results presented apply to determination of adenosine triphosphate in soils, the mass transport effect on algal growth stimulation, and zinc toxicity to the green alga *Selenastrum capricornutum* as a function of

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

phosphorus or ionic strength. The methodology employed by the National Eutrophication Survey in algal assays is described, followed by discussions of frequency analysis of cyclic phenomena in flowing streams, the effect of higher trophic level components in an aquatic ecosystem model, the determination of effects of waste discharges in the Spokane River system (Wash) by algal assays, the effects of nitrogen and phosphorus on the growth of *Seleniastrum capricornutum*, and the use of *in situ* algal assays to evaluate the effects of sewage effluents on the Shagawa Lake (Minn.) phytoplankton. Presented also is the development of a standardized marine algal assay for nutrient assessment in saline waters, the growth requirements of the marine *Enteromorpha compressa* and *Codium fragile*, Great Lakes nutrient assessment, and waste treatment efficiency assessment by the algal assay test. Two concluding papers discuss the utilization of energy by primary producers in Florida ponds, and the heteroinhibition as a factor in *Anabaena flos-aquae* bloom production. (See W77-04154 thru W77-04166) (Auen-Wisconsin) W77-04153

**RESEARCH PERTAINING TO DETERMINATION OF ATP IN SOILS AND SUBSURFACE FORMATIONS,**  
Robert S. Kerr Environmental Research Lab.,  
Ada, Okla.  
For primary bibliographic entry see Field 5A.  
W77-04154

**THE EFFECT OF MASS TRANSPORT ON BIOSTIMULATION OF ALGAL GROWTH,**  
Army Engineers Waterways Experiment Station,  
Vicksburg, Miss.  
J. W. Falco, P. C. Kerr, M. B. Barron, and D. L. Brockway.  
In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 4-27. 11 fig., 3 tab., 15 ref.

Descriptors: \*Algae, \*Growth rates, \*Mass transfer, \*Diffusion, \*Resistance, \*Mathematical models, Turbulence, Nutrients, Absorption, Path of pollutants.

A mathematical model of the uptake of major nutrients limited by diffusion resistance around an algal cell is devised and a series of experiments demonstrating these uptake limitations is discussed. Also developed are models of internal resistance that may limit colonial algae (and aggregated algal cells) and the case of a single limiting nutrient diffusing independently of other material gradients with a non-linear reaction uptake step at the cell wall boundary. The growth of *Chlorella pyrenoidosa* at three concentrations of carbon dioxide and three shake rates indicated that a three- to four-fold stimulation of biological activity was induced for cultures grown at a 17 rpm shake rate versus those grown in still vessels, with no further stimulation occurring when the shake rates were increased to 33 rpm; apparently the major boundary layer resistances are eliminated at the lower shake rate. A Reynolds number quantifies the level of turbulence in the culture, which coupled with the laboratory results, indicates that large diffusional resistance can limit uptake of nutrients in aquatic ecosystems. The limited data indicate that the effect of turbulence on increasing cell growth is less at higher carbon dioxide concentrations. With the diatom *Cyclotella nana* diffusion resistance was calculated to result in a maximum decrease of 40% in phosphorus uptake rate. (See also W77-04153) (Auen-Wisconsin) W77-04155

**TOXICITY OF ZINC TO THE GREEN ALGA SELENIASTRUM CAPRICORNUTUM AS A**

**FUNCTION OF PHOSPHORUS OR IONIC STRENGTH,**  
Pacific Northwest Environmental Research Lab.,  
Corvallis, Ore.

J. C. Greene, W. E. Miller, T. Shiroyama, and E. Merwin.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 28-43. 6 fig., 1 tab., 10 ref.

Descriptors: \*Bioassay, \*Zinc, \*Toxicity, \*Chlorophyta, Phosphorus, Ions, Salts, Specific conductivity, Heavy metals, \*Pollutant identification.

Identifiers: \**Seleniastrum capricornutum*, Algal Assay Procedure Bottle Test.

Experiments are described in which a modification of the Algal Assay Procedure Bottle Test was used to evaluate *Seleniastrum capricornutum* as a bioassay for zinc toxicity and to determine whether relationship exists between zinc toxicity and phosphorus concentrations that would affect the 14-day maximum growth yield of this alga in a defined inorganic medium. Results indicated that phosphorus (as orthophosphorus) in concentrations of 0.047 to 0.930 mg/l did not significantly affect the toxicity of zinc to this alga and that algal cell numbers did not significantly affect the concentration of zinc required to produce 95% inhibition of the 14-day maximum yield. Ionic strength (specific conductance) was the dominant factor regulating zinc toxicity as the sensitivity of the test alga to zinc was inversely proportional to the increase in ionic strength of the test substrates. The factor of 2.72 plus or minus 20% multiplied by the ionic strength (micromhos/cm) of a test substrate will indicate the level of zinc (in microgram/l) that would inhibit 95% growth of the alga provided other antagonistic or synergistic constituents are absent. (See also W77-04153) (Auen-Wisconsin) W77-04156

**ALGAL ASSAYS FOR THE NATIONAL EUTROPHICATION SURVEY,**  
Pacific Northwest Environmental Research Lab.,  
Corvallis, Ore.

For primary bibliographic entry see Field 5A.  
W77-04157

**FREQUENCY ANALYSIS OF CYCLIC PHENOMENA IN FLOWING STREAMS,**  
Army Engineers Waterways Experiment Station,  
Vicksburg, Miss.

P. C. Kerr, J. W. Falco, R. M. Stead, and D. Brockway.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 53-86. 23 fig., 2 tab., 8 ref.

Descriptors: \*Frequency analysis, \*Streams, \*Cycling nutrients, \*Fluctuations, \*Fourier analysis, \*Distribution patterns, Mathematical models, Bacteria, \*North Carolina, Cycles, Computer programs, Nutrients, Path of pollutants, \*Oligotrophy.

Identifiers: Coweta(NC).

Data sets covering a 64-week period and containing measurements of the concentrations of major nutrients and bacteria in two primary oligotrophic streams located in the North Carolina Coweta Hydrologic Station watershed were Fourier transformed by means of a computer program. The transformed coefficients as a function of frequency indicated that non-random variations occurred in all measured parameters, including total organic carbon, total inorganic carbon, carbon dioxide, bicarbonate, total phosphorus, ortho-phosphorus, nitrate-nitrogen, dissolved oxygen, sediment bacteria and suspended bacteria. Changes in nutrient and bacterial cycling patterns are illustrated by the

differences between patterns in the two streams, one in a climax forest and one in a clear-cut watershed. Water bacteria, sediment bacteria, and all forms of inorganic carbon appeared to cycle more rapidly in the perturbed stream. The inverse was true for nitrate-nitrogen, dissolved oxygen, and total organic carbon, with very pronounced differences for nitrate-nitrogen, suspended bacteria and sediment bacteria. Preliminary data indicated that total inorganic carbon, total organic carbon, total phosphorus, and bacterial concentrations are interacting parameters. Significant non-random fluctuations occurred in the major nutrients and bacterial concentrations in both streams—high frequency cyclic variations occurred in total inorganic carbon, total organic carbon, total phosphorus, suspended bacteria and sediment bacteria, and low frequency cycling variations occurred in nitrate-nitrogen. (See also W77-04153) (Auen-Wisconsin) W77-04158

**THE USE OF ALGAL ASSAYS TO DETERMINE EFFECTS OF WASTE DISCHARGES IN THE SPOKANE RIVER SYSTEM,**  
Pacific Northwest Environmental Research Lab.,  
Corvallis, Ore.

W. E. Miller, J. C. Greene, T. Shiroyama, and E. Merwin.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 113-131. 7 fig., 1 tab., 9 ref.

Descriptors: \*Bioassay, \*Mine wastes, Water pollution effects, \*Sewage effluents, Rivers, \*Toxicity, \*Washington, \*Idaho, \*Eutrophication, Heavy metals, Zinc, Industrial wastes, Specific conductivity, Limiting factors, Nitrogen, Phosphorus, \*Pollutant identification.

Identifiers: \*Algal assays, \*Spokane River(Wash), \*Coeur d'Alene River(Idaho).

Algal assays were used to define the effect of heavy metals and wastewater effluents upon the potential growth of algae within the Spokane-Coeur d'Alene River System to determine its nitrogen and phosphorus status, the critical nutrient responsible for algal growth, and the concentration of zinc that would inhibit algal growth. Major nutrient inputs to the river system are from domestic, industrial, agricultural and groundwater intrusion; nitrogen trends indicate increasing nitrate concentrations due to groundwater accretions. Control of nitrogen is complicated by costs and the presence of blue-green algae and other microorganisms capable of fixing atmospheric nitrogen, thus phosphorus was chosen as the controlling constituent to regulate algal productivity. The results indicated that the stimulatory effects of nitrogen and phosphorus decreased proportionally to the zinc concentrations. A 20-fold increase in orthophosphorus loading in sections of the system would have little effect upon algal growth unless the zinc content of these waters is reduced. A natural reduction of zinc from 112 microgram/l at the Spokane STP to 20 microgram/l 23 kilometers downstream from the treatment plant produced algal growth in a ratio to the orthophosphorus content of the water. The addition of chelators (EDTA) and the use of cation exchange resins to remove heavy metal toxicity from test waters prior to algal assay holds considerable promise. (See also W77-04153) (Auen-Wisconsin) W77-04159

**EFFECT OF NITROGEN AND PHOSPHORUS ON THE GROWTH OF SELENIASTRUM CAPRICORNUTUM,**  
Pacific Northwest Environmental Research Lab.,  
Corvallis, Ore.

T. Shiroyama, W. E. Miller, and J. C. Greene.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, Na-

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tional Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 132-142. 6 fig., 8 ref.

Descriptors: \*Bioassay, \*Nitrogen, \*Phosphorus, \*Eutrophication, Methodology, Algae, Growth rates, \*Growth rates, Growth stages, Pollutant identification.

Identifiers: \*Algal Assay Procedure Bottle Test, Algal assay, \**Selenastrum capricornutum* growth.

The Algal Assay Procedure Bottle Test was used throughout this investigation, with a seven-day-old culture of *S. capricornutum* grown in the algal assay medium. Dibasic potassium phosphate and sodium nitrate salts were used as the phosphorus and nitrogen sources. Growth rates of the alga in the medium revealed that the major uptake of phosphorus and nitrogen occurred in the first five days. The higher growth rate observed with phosphorus, as compared to nitrogen, indicates that the test alga assimilates phosphorus more rapidly than nitrogen and that there is a definite linear relationship between biomass produced and the amount of phosphorus and nitrogen present. The determination of phosphorus and nitrogen requirements for the alga indicates that when all other essential nutrients are present and in the absence of any toxicants, the maximum growth responses of the alga can be predicted. Waters containing more than .010 mg/l orthophosphorus will yield 0.43 milligram dry weight of the alga per .001 mg P/l. Similarly, each .001 mg/l total soluble inorganic nitrogen will yield .038 milligrams dry weight of the alga. Actual yield is considered statistically significant with plus or minus 20% of the predicted yield. (See also W77-04153) (Auen-Wisconsin) W77-04160

#### THE USE OF IN SITU ALGAE ASSAY TO EVALUATE THE EFFECTS OF SEWAGE EFFLUENTS ON THE PRODUCTION OF SHAGAWA LAKE PHYTOPLANKTON, Pacific Northwest Environmental Research Lab., Corvallis, Oreg.

P. D. Smith.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 143-173. 8 fig., 7 tab., 29 ref.

Descriptors: \*Bioassay, \*Sewage effluents, \*Tertiary treatment, \*On-site investigations, \*Eutrophication, \*Minnesota, Photosynthesis, Chlorophyll, Algal control, Methodology, \*Pollutant identification, \*Productivity. Identifiers: \*Algal assay, \*Shagawa Lake (Minn).

These experiments were designed to evaluate the effectiveness of a pilot tertiary plant in reducing the capacity of secondary sewage effluent from Ely (Minnesota) to stimulate phytoplankton productivity in nearby Shagawa Lake. Two levels of tertiary treatment were tested: one designed specifically to remove phosphorus (99%) by alum coagulation and filtration (CF system), and treatment which incorporated a column of activated charcoal, and cation and anion exchanges (AE system) capable of removing over 90% of all nutrients. The results indicated that CF and AE tertiary treatment would significantly reduce the trophic level of Shagawa Lake as indicated by the reduced algal growth and specific photosynthesis and that the CF tertiary effluent can be detrimental to some phytoplankton in mixtures more than 10% wastewater. As specific photosynthesis rates are not thoroughly reliable indicators of mixed population activity, it is recommended that assimilation ratios as a response indicator in assays be approached cautiously where chlorophyll-a concentrations exceed 27 mg/cu m. Also suggested is that large test basins be sampled during the filling process to define initial responses and that bioassays should be at least 10 days old to allow the full growth potential of the system. Also noted

is that photosynthesis measurements give a much earlier indication of treatment effects than chlorophyll-a and that chlorophyll-a measurements should consider phaeopigment interference. (See also W77-04153) (Auen-Wisconsin) W77-04161

#### GROWTH REQUIREMENTS OF ENTEROMORPHA COMPRESSA AND CODIUM FRAGILE, Environmental Research Lab., Narragansett, R.I. R. L. Steele.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 213-225. 11 fig., 1 tab., 10 ref.

Descriptors: \*Marine algae, \*Growth rates, Bioassay, Bioindicators, \*Water temperature, \*Light intensity, \*Trace elements, Chlorophyll, Tidal waters, Intertidal areas, Estuaries, Estuarine environment, Water pollution effects, \*Pollutant identification, \*Metals.

Identifiers: Algal assay, \**Enteromorpha compressa*, \**Codium fragile*. W77-04163

Responses of the ubiquitous, rapidly-growing, estuarine algae, *Enteromorpha compressa*, to temperature, illumination, salinity fluctuations, nitrogen, phosphorus, and trace metals were investigated to determine its utility as a pollution indicator and a bioassay tool. The responses to the same parameters of the nuisance *Codium fragile* were also investigated in order to develop control methods, especially in the vicinity of shellfish beds. Details of the test results are presented. Generally, these two estuarine green algae exhibited quite different responses in the laboratory. *Codium* appears to be a species with fairly limited salinity and temperature tolerances. *E. compressa* appears to be definitely stimulated by high enrichment, whereas *C. fragile* is resistant to nutrient enrichment and tends to prefer adequate but lower nutrient levels. *C. fragile* requires a very low level of heavy metals for growth but with abundant heavy metal ions its growth is depressed or halted. *E. compressa* and other *Ulvalces* are abundant in bays and harbors that contain a high degree of organic pollution and raw sewage. *C. fragile* is found in salt ponds or shallow embayments receiving a constant tidal flux, posing the question whether this type of environment ties up or chelates the metal ions, thereby allowing *Codium* to grow abundantly. Tissue differentiation in *Codium* had not been resolved. (See also W77-04153) (Auen-Wisconsin) W77-04164

ASSESSING TREATMENT PROCESS EFFICIENCY WITH THE ALGAL ASSAY TEST, Robert S. Kerr Environmental Research Lab., Ada, Okla. For primary bibliographic entry see Field 5D. W77-04164

darly limiting but in one case it was equal to phosphorus in limiting algal growth. Autoclaving the samples released nutrients which resulted in additional growth. Laboratory tests indicated that on spiked samples there was a 5.0% increase in algal dry weight per increase in each ppb of phosphorus. In laboratory growth experiments with unspiked lake water, there was a 0.5% increase per ppb of total phosphorus. The difference in growth rates probably was caused by the unavailability of the phosphorus in the unspiked samples. Indications were that Lake Michigan was limited primarily by phosphorus and secondarily by nitrogen, with phosphorus limiting the total algal standing crop. Changes in the ppb range of phosphorus substantially changed the standing crop. A phosphorus standard could not be related to the tests. (See also W77-04153) (Auen-Wisconsin) W77-04163

#### UTILIZATION OF ENERGY BY PRIMARY PRODUCERS IN FOUR PONDS IN NORTHWESTERN FLORIDA, Environmental Protection Agency, Gulf Breeze, Fla., Gulf Breeze Environmental Research Lab. G. E. Walsh.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 249-274. 3 fig., 11 tab., 27 ref.

Descriptors: \*Primary productivity, \*Solar radiation, \*Photosynthesis, Energy conversion, \*Florida, Ponds, Cyanophyta, Chlorophyta, Dominant organisms, Carbon dioxide, Photosynthetic oxygen, Energy, Light, Phytoplankton. Identifiers: Pensacola (Fla).

Described are results of investigations of four ponds near Pensacola (Florida) to determine the amount of solar energy incorporated into the first trophic level in each pond, to relate the energy incorporated to the amount of solar radiation, and to determine the efficiency of incorporation of energy absorbed by primary producers into organic compounds. Related studies considered the role of carbon dioxide concentration in limiting the rate of primary production and the changes in phytoplankton over a seasonal cycle. The amounts of solar energy absorbed by photosynthetic processes, estimated from diel and annual oxygen data, were compared with energy required for carbon dioxide fixation. On an annual basis, energy required for oxygen evolution and for carbon dioxide fixation varied widely between ponds and within each pond, as did efficiencies of energy incorporation. For example, the mean annual efficiencies of light absorption were between 0.7 and 3.1% of incident solar radiation. Average annual efficiencies of absorbed solar energy incorporation into organic molecules were between 3.2 and 26.8%. Cyanophyta dominated all ponds during most of the year and attained greatest numbers between April and October. Photosynthetic quotients were highest during their blooms. Increased fat production may explain why the energy required for carbon dioxide fixation increased during summer. (See also W77-04153) (Auen-Wisconsin) W77-04165

#### HETEROINHIBITION AS A FACTOR IN ANABENA FLOS-AQUAE WATERBLOOM PRODUCTION, Environmental Monitoring and Support Lab., Las Vegas, Nev.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

L. R. Williams.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 275-317. 8 fig., 3 tab., 35 ref., 4 append.

Descriptors: \*Cyanophyta, Anabaena, \*Eutrophication, \*Inhibition, \*Plant growth substances, Laboratory tests, On-site investigations, \*New Jersey, Exudation, Algal toxins, Chlorophyta, Light intensity, Water temperature, Bioassays.

Identifiers: \*Anabaena flos-aquae, \*Lake Nelson(NJ).

Laboratory and on-site investigations suggested that an interaction of conditions, and not a single causative factor, leads to the dominance of Anabaena flos-aquae blooms with the occasional codominance of *Microcystis aeruginosa* in late summer, warm water conditions in New Jersey ponds and lakes. Results showed that the trigger for initial Anabaena blooms is its response to the warming of hypolimnetic waters. A filament grows from the benthic overwintering Anabaena cell and competes successfully in lake summer. Anabaena exudes into the water a compound which inhibits the growth of a broad spectrum of algal species. Then, upon death and lysis of the inhibited cells, inorganic and organic compounds are liberated into the system, thus stimulating the advancing Anabaena population. The high concentration of Anabaena filaments on the surface, largely due to the extensive pseudovacuole formation and phototaxis, is the resultant waterbloom and is composed of senescent Anabaena filaments. Filaments from surface waters were incapable of further growth, thus concentration by filament proliferation is doubtful. A bioassay procedure is suggested for testing the nature and effect of Anabaena heteroinhibition and assays with the active fraction can then aid in the purification and ultimate identification of these inhibitors. The precise conditions governing filament growth from akinetes, heterocyst production, phototactic behavior, and the formation of the pseudovacuoles have not been defined. (See also W77-04153) (Auen-Wisconsin)

W77-04166

**HEAVY METAL LEVELS IN SUSPENDED PARTICULATES, BIOTA, AND SEDIMENTS OF THE ST. CROIX ESTUARY IN MAINE,**  
Maine Univ., Walpole. Dept. of Oceanography.  
For primary bibliographic entry see Field 5B.  
W77-04176

**CAUSES OF THE PREDOMINANCE OF COCCI IN BACTERIO-PLANKTON OF FISH-BREEDING PONDS, (IN RUSSIAN),**  
Ukrainian Research Inst. of the Fish Industry, Kiev (USSR).  
A. F. Antipchuk.  
Gidrobiol Zh 11(6); p 64-66, 1975.

Descriptors: \*Bacteria, Nutrients, \*Reproduction, \*Productivity, Energy, Fish, \*Plankton, Ponds, Soil Fish hatcheries, Water pollution effects.

Identifiers: Achromobacter-album, Achromobacter-punctatum, Achromobacter-superficialis, Bacillus-megaterium, Bacillus-mesentericus, Bacillus-mycooides, \*Cocci, Micrococcus-aquaticus, Micrococcus-candicans, Micrococcus-candidus, Micrococcus-lardarius, Serratia-indica, \*USSR, \*Bacilli, \*Bacterio-plankton.

Comparative data are presented on the reproduction rate, productivity and degree of utilization of energy by cocci (*Micrococcus aquaticus*, *M. lardarius*, *M. candidus*, *M. candidans*), bacteria (*Achromobacter punctatum*, *Bacterium indicum* (*Serratia indica*), *A. superficialis*, *A. album*) and *bacillus mycooides*, *B. megaterium* and *B. mesentericus*. The data obtained permitted the consideration that the predominance of cocci in the

107 investigated fish-breeding ponds of different soil and climatic zones of the Ukrainian SSR (USSR) is due to their more rapid reproduction and more intense utilization of the energy of nutrients.—Copyright 1976, Biological Abstracts, Inc.

W77-04183

**STATE OF OREGON COASTAL ZONE MANAGEMENT PROGRAM, DRAFT ENVIRONMENTAL IMPACT STATEMENT,**  
National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management.

For primary bibliographic entry see Field 6G.

W77-04184

**PROPOSED FEDERAL APPROVAL OF THE COASTAL ZONE MANAGEMENT PROGRAM, MID-COAST SEGMENT, STATE OF MAINE, DRAFT ENVIRONMENTAL IMPACT STATEMENT.**

National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management.

For primary bibliographic entry see Field 6G.

W77-04185

**BARATARIA BASIN: BIOLOGICAL CHARACTERIZATION,**

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.

For primary bibliographic entry see Field 2L.

W77-04188

**OIL BIOASSAYS WITH THE AMERICAN OYSTER, CRASSOSTREA VIRGINICA**

(GMELIN),

Texas A and M Univ., College Station.

R. D. Anderson, and J. W. Anderson.

Reprinted from: Proceedings of the National Shellfisheries Association, Vol 65, p 38-42, 1976. 1 fig, 3 tab, 13 ref. SG-04-3-158-18.

Descriptors: \*Bioassays, \*Oysters, \*Toxicity, \*Oil pollution, Water pollution, \*Baseline studies, \*Environmental effects, Mortality, Animal behavior, Shellfish, Lethal limit, Toxicity, Pollutant identification.

Identifiers: Petroleum hydrocarbons, Hazardous compounds, Dispersants, Sublethal effects.

Oyster bioassays were conducted to determine the relative toxicity of four test oils and a reference toxin. The oysters (*Crassostrea virginica*) were exposed to oil-water dispersion of two crude and two partially refined petroleum hydrocarbons. The partially refined oils 2 fuel and Venezuela bunker C were found to be more toxic than the two crude oils tested, South Louisiana and Kuwait. Oysters demonstrated greater resistance to test oils than to the reference toxin, dodecyl sodium sulfate. Valve closure by oysters made it difficult to determine percent mortality data in 96-hour or extended studies. Composition of test solutions is compared to calculated values of oil in water and referenced to the relative toxicity demonstrated. Behavior and conditions of test animals is discussed in relation to bioassay results. (NOAA)

W77-04189

**ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. VOLUME 1. PRINCIPAL INVESTIGATORS' REPORTS APRIL-JUNE 1976.**

National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

For primary bibliographic entry see Field 6G.

W77-04200

**ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. VOLUME 2. PRINCIPAL INVESTIGATORS' REPORTS APRIL - JUNE 1976.**

National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

For primary bibliographic entry see Field 6G.

W77-04201

**RAPID DETECTION OF VARIOUS KINDS OF HERBICIDES IN WATER BY THE IN VIVO DETERMINATION OF NITRATE REDUCTASE ACTIVITY IN LEMNA MINOR, (IN FRENCH),**  
Institut de Recherches Chimiques, Tervuren (Belgium).

M. Declerck, W. De Cat, and R. Bastin.  
Z Pflanzphysiol 77(4), p 315-322, 1976.

Descriptors: \*Herbicides, Nitrates, Nutrients, Pollutant identification, Organic compounds, Ureas, Plant physiology, Chlorophyll, Phenols, Inhibition, Plant growth.

Identifiers: Amides, Anilines, Benzonitriles, Diazines, Dinitroerb, Diquat, \*Lemna-minor, Propanol, Pyridiniums, Triazines, \*Nitrate reductase(Plants).

L. minor plants were laid on nutrient solutions containing different herbicides at concentrations of 0.05; 0.1; 0.5 and 1 mg/l. The nitrate reductase activity was measured after 20h; fresh weight and chlorophyll content were determined after 5 days. The nitrate reductase activity was inhibited in Lemna in contact with the following groups of herbicides; triazines, ureas, diazines, bipyridiniums, phenols and benzonitriles, but not with dinitroanilines and amides, except propanol. A concentration of 1 mg/l resulted in the same inhibition of growth and nitrate reductase activity. At 0.5 and 0.1 mg/l, the correlation remained valid, chiefly for triazine, urea and diazine herbicides, but also for propanol, dinitroerb and diquat. At 0.05 mg/l, the inhibition of nitrate reductase activity is too low to give significant results.—Copyright 1976, Biological Abstracts, Inc.

W77-04261

**SOME THERMAL AND BIOLOGICAL EFFECTS OF FOREST CUTTING IN WEST VIRGINIA,**

West Virginia Univ., Morgantown. Div. of Forestry.

R. Lee, and D. E. Samuel.

Journal of Environmental Quality, Vol. 5, No. 4, p 362-366, October-December 1976. 5 fig, 5 tab, 13 ref.

Descriptors: \*Lumbering, \*West Virginia, \*Water quality, \*Small watersheds, Forest management, Clear-cutting, Water temperature, On-site investigations, Forests, Ponds, Streams, Aquatic insects, Diptera, Benthic fauna, Measurements, Forest watersheds.

Water temperature, benthic fauna, and aquatic insect emergence were observed in four small watersheds to document the effects of forest cutting. During the summer months, complete cutting caused mean temperature increases greater than 4C, and maximum temperature increases greater than 9C. The changes diminished to about one-half after 3 years of natural hardwood regeneration. Complete cutting more than tripled the mean weekly range of stream temperature during summer, and it decreased mean minimum temperatures during winter months by about 2C. Two orders, Diptera and Pelecypoda, accounted for most of the benthic biomass in watershed weir ponds; the former predominated in clear-cut watershed ponds, and the latter predominated in a control (forested area) pond. The control pond produced by far the highest total numbers and biomass of benthic fauna, and the greatest numbers of aquatic insects. (Humphreys-ISWS)

W77-04273

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

**X-RAY ANALYSIS OF SHORTENED BACKBONES IN FISHES: A COD (GADUS MORHUA L.) AND B. ALLIS SHAD (ALOSA ALOSA L.), (IN GERMAN),**  
Erlangen-Nuremberg Univ. (West Germany).  
Zoologisches Institut.  
For primary bibliographic entry see Field 5A.  
W77-04278

**EXPLAINING VARIATIONS IN CARDIOVASCULAR DISEASE MORTALITY WITHIN A SOFT WATER AREA,**  
Massachusetts Univ., Amherst. School of Health Sciences.

R. W. Tuthill.

Available from the National Technical Information Service, Springfield VA 22161 as PB-263 482, Price codes: A05 in paper copy, A01 in microfiche. Massachusetts Water Resources Research Center, Amherst, Publication No. 75, August 1976, 73 p, 3 fig, 15 tab, 59 ref, 6 append. OWRT A-089 Mass(1), 14-34-0001-6022.

Descriptors: \*Public health, \*Toxicity, \*Water quality, \*Potable water, \*Mortality, Social aspects, \*Massachusetts, Human diseases.

Identifiers: \*Cardiovascular deaths, Trace metals, \*Soft water areas(Mass).

A multivariate step-wise regression procedure was used to assess the relationship of eighteen water constituents to some twelve categories of sex specific age adjusted mortality ratios for 215 communities in the Commonwealth of Massachusetts, an essentially soft water area. Thirteen social factors were included in the analysis as control variables. For both males and females, magnesium was negatively correlated with sudden deaths. This relationship persisted even when social variables were included in the equation. No other significant water variables emerged in the analysis. In fifteen of the twenty-four sex specific mortality categories social variables explained a statistically significant and substantive proportion of variance. Those categories of mortality where there was a consistent strong association with social variables for both males and females were: hypertension, heart disease, sudden death, ischemic heart deaths before age 65, deaths from all causes and deaths from all causes before age 65. (Lefferts-Mass) W77-04295

**POTENTIAL IMPACT OF THE DEVELOPMENT OF LIGNITE RESERVES ON WATER RESOURCES OF EAST TEXAS,**  
Texas A and M Univ., College Station. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5B.

W77-04297

**LAND USE PATTERNS, EUTROPHICATION AND POLLUTION IN SELECTED LAKES,**  
Vermont Univ., Burlington. Dept. of Agricultural and Resources Economics.

F. O. Sargent.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 501, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, July 14, 1976. 47 p, 12 tab, 19 ref, append. OWRT A-019-VT(1), 14-34-0001-6047.

Descriptors: Lakes, Planning, Management, Classification, Monitoring, Water quality, \*Land use, \*Eutrophication, Lake basins, Water pollution. Identifiers: Lake rehabilitation.

The principal contributions of this project were development of: (1) a lake vulnerability classification system, (2) a lake basin land use intensity index, and (3) a survey of literature concerning techniques of lake management and rehabilitation. The lake vulnerability index is designed to indicate the extent of the lake's vulnerability to accelerated cultural eutrophication by calculation of five fac-

tors: the ratio of the lake drainage area to lake volume, the ratio of the shoreline to the circumference of a circle equal to the lake area, the ratio of the lake volume in cubic feet to the lake area and square feet over the mean depth, the amount of the lake bottom area whose depth is less than 20 feet below the surface, and the lake water mean hydrologic residence time. The lake basin land use intensity index is designed to indicate the relative level of lakeshore and upland land use and abuse with reference to water quality. It is based on seven parameters: onsite soil absorption sewage disposal system, lot sizes, road proximity, intensive public use areas, intensive upland development areas, forest cover, and agricultural and open space land uses.

W77-04298

**BIO MASS AND REMOTE SENSING OF AQUATIC MACROPHYTES IN THE PAMlico RIVER ESTUARY,**  
East Carolina Univ., Greenville. Dept. of Biology.

T. M. Vicars, Jr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 705, Price codes: A06 in paper copy, A01 in microfiche. M. A. Thesis, June 1976. 108 p, 22 tab, 13 fig, 41 ref. OWRT A-077-NC(9), 14-31-0001-5033.

Descriptors: \*Aquatic plants, \*Aerial photography, \*Remote sensing, \*Submerged aquatic plants, Turbidity, Wind, Currents, Water level fluctuations, Field investigations, \*North Carolina, Estuaries, Estuarine environment, \*Biomass, Ecosystems, Water pollution effects. Identifiers: \*Pamlico River estuary(NC), \*Macrophytes(Aquatic).

The purpose was to determine what ecosystem functions are served by submersed aquatic plants (macrophytes) in the Pamlico River estuary of North Carolina. Aerial photography was used successfully to map submersed plant beds. Coverage of macrophytes varied considerably during the growing season but maximum coverage was relatively stable between 1974 and 1975, especially in upstream areas. Field studies in 1974 showed that the biomass of macrophytes ranged from 2.3 - 50 g/m<sup>2</sup> organic dry weight (ODW), and total biomass in August 1975 was 22 - 100 g/m<sup>2</sup> ODW, with highest values upstream and in deep water beds. Through the combined use of aerial photography and field studies total biomass estimates were made. These estimates were 104 MT (metric tons) ODW in August 1974 and 198 MT ODW in August 1975. High biomass was related to physiography of the littoral, stable salinity and reduced wind and wave stress. Studies of plant bed distribution patterns revealed that turbidity, fluctuating water levels and currents were important factors affecting colonization. (Stewart-No Carolina State) W77-04325

**PRIMARY PRODUCTIVITY AND BIOMASS DISTRIBUTION OF AQUATIC MACROPHYTES IN THE LOWER CHOWAN RIVER,**  
East Carolina Univ., Greenville, N. C. Dept. of Biology.

L. R. Blanton, Jr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 668, Price codes: A05 in paper copy, A01 in microfiche. M. S. Thesis, August 1976. 85 p, 16 tab, 12 fig, 53 ref, append. OWRT B-079-NC(3), 14-31-0001-5098.

Descriptors: \*Rooted aquatic plants, Aquatic plants, Aquatic weeds, \*Primary productivity, \*North Carolina, Rivers, \*Biomass, \*Distribution, Water pollution effects, Coastal plains.

Identifiers: \*Chowan River(NC), \*Aquatic macrophytes, \*Yellow water lily, \*Nuphar luteum, \*Justicia americana.

Primary productivity was determined for the two dominant rooted aquatic macrophytes, Nuphar lu-

teum (L.) Sibthorp & Smith, and Justicia americana (L.) Vahl., in the lower Chowan River, North Carolina. The 1975 annual net production for N. luteum was 228.1 g dry wt/m<sup>2</sup> with a peak biomass range of 115-299 g dry wt/m<sup>2</sup>. The average annual turnover rate for floating leaves and petioles was 5.7 times per year. Root productivity was calculated by assuming the same turnover rate as for rhizomes (0.14 per year) and by assuming a constant root-to-rhizome ratio. The average percent ash for N. luteum ranged from 9.1 (floating leaves) to 17.0 (roots). Generally, 77% of the N. luteum biomass was in the substrate, while 93% of the net primary productivity was contributed by above ground structures. Justicia americana reached a peak biomass of 276.5 g dry wt/m<sup>2</sup> in August 1975 which probably approximated seasonal net primary productivity based on uniform growth and observed low mortality. Biomass distribution for the aquatic macrophytes was estimated by aerial color photography at approximately 366 m (1,200 ft). Total macrophyte coverage was 277,306 m<sup>2</sup> (ca. 27.7 ha) of which 1% was J. americana. Biomass data from an extensive sampling survey for N. luteum (223.1 g dry wt/m<sup>2</sup>) coupled with aerial coverage (ca. 272,267 m<sup>2</sup>) gave an estimate of 60.7 MT of plant biomass for the study area. (Stewart-North Carolina State) W77-04326

**PROCESSES OF DISSOLVED OXYGEN DEPLETION IN TIMS FORD RESERVOIR,**  
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.

B. Skelton.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 667, Price codes: A07 in paper copy, A01 in microfiche. M. S. Thesis, August 1976. 124 p, 49 fig, 7 tab, 42 ref. OWRT A-040-Tenn.(2).

Descriptors: \*Dissolved oxygen, Reservoir storage, Water quality, \*Biochemical oxygen demand, \*Tennessee, Density stratification, Thermal stratification, Phytoplankton, Benthos, Respiration, Water pollution effects.

Identifiers: \*Tims Ford Reservoir(Tenn), \*Dissolved oxygen depletion, Metalimnic zone, Benthic zone.

The purpose was to identify, document and quantify the mechanisms of dissolved oxygen depletion occurring in a deep temperature-density stratified reservoir having a long hydraulic detention time. This study was conducted to aid in reservoir water quality modeling and management. A thorough analysis of 1973 and 1974 water quality data from Tims Ford Reservoir was conducted. The data relating to physical, chemical and biological conditions were obtained from the Tennessee Valley Authority. Results showed that serious dissolved oxygen depletion was apparent mainly in the metalimnic and benthic zones. The mechanism which was the primary cause of oxygen depletion was long-term biochemical oxygen demand (BOD28). Sharp increases in concentrations of BOD28 and phytoplankton were observed in the metalimnic minimum. These increases were due to a decreasing settling velocity gradient caused by rapidly decreasing temperatures in the thermocline. Also, large numbers of zooplankton migrate to this zone to graze upon the phytoplankton. Therefore, the metalimnic minimum was caused from BOD28 and plankton respiration. In the benthic zone, releases of BOD1, manganese, and iron from anaerobic bottom sediments contributed approximately 82 percent (1973) and 97 percent (1974) of the total oxygen uptake. W77-04327

**DEEP-SEA BACTERIA: GROWTH AND UTILIZATION OF N-HEXADECANE AT IN SITU TEMPERATURE AND PRESSURE,**  
Maryland Univ., College Park. Dept. of Microbiology.

J. R. Schwarz, J. D. Walker, and R. R. Colwell.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Available from the National Technical Information Service, Springfield, VA 22161 as ADA-016502. Price codes: A02 in paper copy, A01 in microfiche. Canadian Journal of Microbiology, Vol. 21, No. 5, p. 682-687, 1975. 1 fig, 3 tab, 15 ref.

Descriptors: \*Aquatic bacteria, Deep water, \*Water temperature, \*Pressure, \*Carbon cycle, \*Growth rates, Pollutants, \*Oil, \*Organic compounds, \*Microbial degradation, Laboratory tests, Productivity, Environmental effects, Path of pollutants, Florida, Sampling.

Identifiers: \*Hexadecane, \*Deep-sea bacteria, *Aeromonas* spp, *Pseudomonas* spp, *Vibrio* spp.

A mixed culture of bacteria was obtained from the sediment-water interface of a core sample taken off the coast of Florida at a depth of 4940 m. The mixed culture was found capable of utilizing hexadecane as a sole carbon source for growth at the in situ temperature (4°C) and pressure (500 atm). The rate of utilization under deep-ocean conditions was found to be much slower than the rate observed at ambient pressure (1 atm) and low temperature (4°C). (Katz) W77-04328

**EFFECTS OF MERCURY ON SURVIVAL AND DEVELOPMENT OF THE LARVAL GRASS SHRIMP *PALAEMONETES VULGARIS*,**  
South Carolina Wildlife and Marine Resources Dept., Charleston, Marine Resources Center. M. H. Shealey, Jr., and P. A. Sandifer. *Marine Biology*, Vol 33, No 1, p 7-16, 1975. 4 tab, 5 fig, 30 ref.

Descriptors: \*Mercury, \*Bioassay, \*Shrimp, \*Toxicity, \*Lethal limit, \*Larval growth stage, Environmental effects, \*Heavy metals, Water pollution effects, Larvae, Growth stages, Laboratory tests, Crustaceans, Shellfish, Invertebrates, Metabolism.

Identifiers: \*Sublethal effects, \*Palaemonetes sp.

Effects of seven concentrations of mercury from 0.0 (control) to 0.056 ppm on survival and development of the larval grass shrimp (*Palaemonetes vulgaris*) were investigated. A concentration of 0.056 ppm mercury was toxic to all larvae within 24 h, below a threshold level (less than or equal to 0.0056 ppm) no lethal effect occurred within 48 h. Feeding appeared to increase the resistance of *P. vulgaris* larvae to mercury, and 48-h median tolerance limits for fed and unfed larvae were 0.0156 and 0.0100 ppm, respectively. Delayed effects of 48-h exposure to sublethal mercury concentrations which appeared in later post-exposure rearing of the larvae included reduced survival to the post larval stage, delayed molting, extended development time, increased numbers of larval instars, and morphological deformities. (Katz) W77-04331

**UPTAKE AND RELEASE OF PHOSPHOROUS BY PHYTOPLANKTON IN THE CHESAPEAKE BAY ESTUARY, USA,**  
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst. J. L. Taft, W. R. Taylor, and J. J. McCarthy. *Marine Biology*, Vol 33, p 21-32, 1975. 6 tab, 3 fig, 46 ref.

Descriptors: \*Kinetics, \*Nutrient removal, \*Organophosphorous compounds, \*Phytoplankton, \*Phosphorous, \*Phosphates, \*Chesapeake Bay, \*Cycling nutrients, On-site investigations, \*Primary productivity, Metabolism, Phosphorus compounds, Absorption, Methodology.

The phytoplankton uptake and release rates for inorganic phosphate, dissolved organic phosphate and polyphosphate were estimated during five cruises on the Chesapeake Bay over a 9-month period. Phosphorous in all pools turned over in several minutes to 100 h, and each soluble pool ap-

peared to contain fractions which were metabolically useful to the phytoplankton. Maximal uptake rates for orthophosphate ranged from 0.02 to 2.95 micrograms-<sup>2</sup> P per hour with half saturation constants between 0.09 and 1.72 microgram-<sup>2</sup> P per liter. At low soluble reactive phosphorous concentrations, the uptake rate of trace 32P orthophosphate was initially rapid, but declined after 15 to 60 minute incubation. The data suggest that the initial uptake phase was dominated by exchange of 32P-4-3 for 31PO-4-3 in the membrane transport systems whereas the subsequent phase represented the net incorporation of orthophosphate into phytoplankton cells. (Katz) W77-04332

**DISTRIBUTION AND ABUNDANCE OF ICHTHYOPLANKTON IN THE NEW YORK BIGHT DURING THE FALL IN 1971,**  
New York Ocean Science Lab., Montauk. For primary bibliographic entry see Field 5B. W77-04333

**BACTERIAL ATTACK OF CORALS IN POLLUTED SEAWATER,**  
Harvard Univ., Cambridge, Mass. Lab. of Applied Microbiology. R. Mitchell, and I. Chet. *Microbial Ecology*, Vol 2, No 3, p 227-233, 1975. 3 tab, 1 fig, 16 ref

Descriptors: \*Water pollution effects, \*Oil, \*Copper sulfate, \*Aquatic bacteria, \*Oil wastes, \*Beggiatoa, \*Mortality, \*Microorganisms, \*Coral, \*Reefs, \*Aquatic animals, \*Stress, \*Animal pathology, Bactericides, Bacteria, Laboratory tests, Environmental effects, Atolls, Dissolved oxygen, Antibiotics(Pesticides). Identifiers: *Platygira*, *Desulfovibrio*, Mucus production.

Coral heads of the genus *Platygira* exposed to low concentrations of crude oil, copper, sulfate, potassium phosphate, or dextrose were killed in periods of 5 to 10 days in aquarium studies. The chemicals stimulated the production of large quantities of mucus by the corals. In aquaria treated with antibiotics to prevent microbial growth, *Platygira* survived the presence of these chemicals in the water, indicating a role of the microflora in the death of the corals. Evidence was obtained implicating predatory bacteria, *Desulfovibrio* and *Beggiatoa*, in the destruction of the stressed coral colonies. (Katz) W77-04335

**LEVELS OF PCB AND TRACE METALS IN WATERFOWL IN NEW YORK STATE,**  
New York State Dept. of Health, Albany. For primary bibliographic entry see Field 5A. W77-04336

**RESIDUE DYNAMICS OF DI-2-ETHYLHEXYL PHthalate IN FATHEAD MINNOWS (*Pimephales promelas*),**  
Fish and Wildlife Service, Columbia, Mo. Fish-Pesticide Research Lab. F. L. Mayer.

Journal of the Fisheries Research Board of Canada, Vol 33, p 2610-2613, 1976. 2 tab, 1 fig, 18 ref.

Descriptors: \*Water pollution, Pollutants, \*Industrial wastes, \*Absorption, \*Metabolism, \*Plastics, \*Path of pollutants, \*Bioassay, \*Minnows, Laboratory tests, Biodegradation. Identifiers: \*DEHP(Di-2-ethylmethyl phthalate), \*Phthalates, Half-life, Residues.

Fathead minnows (*Pimephales promelas*) were continuously exposed to 1.9-62 microgram/liter di-2-ethylhexyl phthalate (DEHP) for 56 days. The accumulation factors ranged downward from 886 to 155 as the exposure concentrations increased.

The major metabolite of DEHP was the monoester 2-ethylhexyl phthalate. After being placed in uncontaminated water, the fish eliminated half of the DEHP in 12.2 days. (Katz) W77-04338

**BIOASSAYS ON THE COMBINED EFFECTS OF CHLORINE, HEAVY METALS, AND TEMPERATURE ON FISHES AND FISH FOOD ORGANISMS. PART I. EFFECTS OF CHLORINE AND TEMPERATURE ON JUVENILE BROOK TROUT (*Salvelinus fontinalis*),**  
Battelle Pacific Northwest Labs., Richland, Wash. Ecosystems Dept.

T. O. Thatcher, M. J. Schneider, and E. G. Wolf. *Bulletin of Environmental Contamination and Toxicology*, Vol 15, No 1, p 40-48, 1976. 1 fig, 2 tab, 20 ref.

Descriptors: \*Water temperature, \*Chlorine, \*Bioassay, Environmental effects, \*Brook trout, \*Mortality, \*Lethal limit, Power plants, \*Pesticide residues, \*Toxicity, Thermal pollution, Water pollution sources, Laboratory tests, Water quality, Salmonids, Trout, Fish food organisms. Identifiers: \*Synergistic effects.

Chlorine is used extensively as an antifouling agent in the cooling systems of power plants and commonly appears in power plant effluents. 96-hr LC<sub>50</sub> values for exposure to chlorine were determined for brook trout (*Salvelinus fontinalis*) in flow-through bioassays at 10, 15, and 20°C. There was no significant difference between the LC<sub>50</sub> value at 10 and 15°C but it was significantly less at 20°C, indicating a synergistic reaction between chlorine and water temperature only at 20°C. Delayed mortality, after the completion of the 96-hr bioassay was not observed. It was observed, however, that higher mortality occurred in the first 48 hrs of testing in fish exposed to the greatest temperature shock. (Katz) W77-04339

**THE USE OF RECOVERY AS A CRITERION FOR TOXICITY,**  
University Coll. of North Wales, Menai Bridge. Marine Science Labs. For primary bibliographic entry see Field 5A. W77-04340

**TEST OF A MODEL FOR PREDICTING THE BODY BURDEN OF TRACE CONTAMINANTS IN AQUATIC CONSUMERS,**  
Oak Ridge National Lab., Tenn. Environmental Sciences Div.

J. W. Elwood, and L. D. Eyman. *Journal of the Fisheries Research Board of Canada*, Vol. 33, p. 1162-1166, 1976, 2 fig., 16 ref.

Descriptors: \*Path of pollutants, \*Statistical models, \*Sunfishes, \*Tracers, \*Cesium, \*Absorption, \*Food chains, \*Food webs, \*Bioassay, Retention, \*Water pollution effects, Laboratory tests, Radioisotopes, Laboratory tests, Forecasting. Identifiers: \*Bioaccumulation, *Lepomis* sp.

A model for predicting the accumulation and retention of trace contaminants obtained through food ingestion in aquatic consumers was tested for short-term exposure conditions. Model parameters were determined in a single-feeding experiment using bluegill (*Lepomis macrochirus*) and food labeled with 137-Cs contaminated food over a 16 day period and the predicted and measured body burden of the radionuclide were compared. The model realistically simulated the absorption of 137-Cs from the gastrointestinal tract and its accumulation over the 16-day period. Average body burden of 137-Cs in bluegill was within 25% of the predicted body burden when the experiment was terminated. Apparent equilibrium of 137-Cs in bluegill by day 16 suggests that this two-compartment linear model does not apply to the long-term

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

accumulation of cesium in fish. The model appears most applicable for predicting body burdens of trace contaminants under acute exposure conditions that simulate an accidental release. (Katz) W77-04341

#### ANTIMYCIN: UPTAKE, DISTRIBUTION, AND ELIMINATION IN BROWN BULLHEADS (Ictalurus nebulosus),

Bureau of Sport Fisheries and Wildlife, Warm Springs, Ga. Southeastern Fish Control Lab.

D. P. Schultz, and P. D. Harman.

Journal of the Fisheries Research Board of Canada, Vol. 33, No. 6, p. 1121-1129, May, 1976.

Descriptors: \*Toxicants, \*Bullheads, \*Tracers, \*Pesticides, \*Absorption, \*Antimycin A, \*Pesticide residues, \*Decomposition, Fish Control Agents, Analytical techniques, Stability, Public health, Catfishes, Freshwater fish, Laboratory tests, Radioisotopes, Analytical techniques, Path of pollutants, Pesticides. Identifiers: \*Tissue analysis.

Radioactive antimycin was readily taken up in bile and tissues of brown bullheads (*Ictalurus nebulosus*) exposed to 0.045 microgram/ml of radiolabeled antimycin for an long as 47h. Bile contained the most and blood the least radioactivity at all sampling periods. The highest concentration of labeled antimycin in muscle was 0.12 microgram/gr after 12 hr of exposure. The average amount of labeled antimycin per fish was 0.94 microgram/gr. Antimycin concentration decreased with elapsed time in the muscle, and in samples of combined head, skin and viscera. The initial half-life of antimycin in the exposure solution was about 6.5 h. A second group of fish were exposed to the same level of antimycin for 48 h and then were transferred to antimycin free, flowing water for up to 96 h. Half-life of labeled antimycin was about 75-h in muscle and 61-h in the combined head, skin, and viscera. (Katz) W77-04342

#### THE METAZOAN FAUNA OF A SEWAGE-CARRYING WADI, NAHAL SOREQ (JUDEAN HILLS, ISRAEL),

Hebrew Univ., Jerusalem (Israel). Dept. of Zoology.

H. J. Bromley, and F. D. Por.

Freshwater Biology, Vol. 5, p. 121-133, 1975, 2 tab., 3 fig., 17 ref.

Descriptors: Populations, \*Nematodes, \*Water purification, \*Self purification, \*Microorganisms, \*Aquatic bacteria, Aquatic populations, \*Sewage, \*Diptera, \*Biological communities, Water quality, Pollution abatement, Seasonal, Biodegradation, Sewage bacteria, Insects, Invertebrates, Algae, Water quality. Identifiers: Chironomus zone, \*Proasellus zone, Israel.

An analysis of the metazoan fauna of a polluted wadi showed three zones of indicator organisms which vary with degree of purification: a polytopic zone (Nematode zone), a mesotopic zone (Chironomus zone), and an oligotopic zone (Proasellus zone). A comparison is made of the saprobic zones and corresponding fauna with polluted streams in Europe, North America, and South Africa. Seasonal changes in species composition are related to life cycle habits in some air-breathing dipterans and change in position of chironomids downstream, due to winter rain floods. It is suggested that the degree of pollution is the primary factor in the establishment and population build-up of any particular species, but the presence of suitable substrates, availability of food and presence of predators play a larger part where the water is cleaner. (Katz) W77-04343

#### BURROWING ACTIVITY IN MERCENARIA MERCENARIA (L.) AND SPISSA SOLIDISSIMA (DILLWYN) AS A FUNCTION OF TEMPERATURE AND DISSOLVED OXYGEN,

Rhode Island Univ., Kingston. Graduate School of Oceanography.

N. B. Savage.

Marine Behavior and Physiology, Vol. 3, p. 221-234, 1976, 5 fig., 5 tab., 12 ref.

Descriptors: \*Water temperature, \*Mussels, \*Clams, \*Environment effects, \*Dissolved oxygen, Animal behavior, \*Lethal limit, \*Benthic fauna, Crustaceans, Burrows, Laboratory tests, Commercial shellfish, Behavior.

Identifiers: \*Mercenaria mercenaria, \*Spisula solidissima, Hard shell clam, Atlantic surf clam.

Burrowing activity was utilized as a measure of the ability of the hard shell clam (*Mercenaria mercenaria*) and the Atlantic surf clam (*Spisula solidissima*) to cope with extremes of temperature and dissolved oxygen. Clams were removed from clean sand substrate and the progress of reburial timed. Experiments were conducted in a once through circulating seawater system in which temperatures were maintained at selected increments above ambient temperatures. Results indicated a zone of optimum activity, above and below which burrowing declined with changing temperature. Thermal optima, upper limits of activity, and burrowing rates were found to be species specific. Ability of *M. mercenaria* to burrow, when exposed to oxygen impoverished conditions (less than 1 mg of oxygen per liter of seawater) for up to three weeks, was not severely or permanently impaired. (Katz) W77-04345

#### CHANGES IN HEMOSTATIC PARAMETERS IN FISH FOLLOWING RAPID DECOMPRESSION,

Washington Univ., Seattle. Fisheries Research Inst.

E. Casillas, S. E. Miller, L. S. Smith, and B.

D'Aoust.

Undersea Biomedical Research, Vol. 12(4), p 267-276, December, 1975, 3 tab., 1 fig., 16 ref.

Descriptors: Animal physiology, \*Salmon, Environment, \*Gases, Water pollution, \*Supersaturation, Fresh water fishes, Nitrogen, Oxygen, Laboratory tests, Laboratory animals, Methodology.

Identifiers: \*Gas bubble disease, \*Hemostatic parameters, \*Decompression, Blood coagulation, \*Coho salmon, Prothrombin, Hemostatic mechanism.

The effect of rapid decompression on the stress-accelerated blood coagulation system of male and fingerling coho salmon (*Oncorhynchus kisutch*) was examined after simulated 100- and 200-fsw dives. Blood samples taken either through a dorsal aorta cannula or from a severed caudal peduncle were analyzed for total plasma protein and fibrinogen concentrations, prothrombin times (PT) and partial thromboplastin times (PTT). The effect of mild decompression (100-fsw) on the hemostatic mechanism of both adult and fingerling coho salmon indicated an alternating fibrinogen concentration, declining from normal levels 1 min after decompression, followed by an increase 10 to 15 min later with an eventual loss of fibrinogen to one half the original level an hour after decompression. Partial thromboplastin times were found to increase 10 to 15 min after decompression occurred. Prothrombin times showed an increase 1 hour after decompression in adult salmon, whereas in fingerlings, prothrombin times increased almost immediately from normal levels. The effect of severe decompression (200-fsw) showed similar trends, but an accelerated rate. It was concluded that both mild and severe decompression activates the hemostatic mechanism of fish which may eventually result in consumption coagulopathy at a greater rate than reported for experimental mammals. (Katz) W77-04400

#### EFFECTS OF AIR-SUPERSATURATED WATER ON ADULT SOCKEYE SALMON (ONCORHYNCHUS NERKA),

Corvallis Environmental Research Lab., Oreg. Western Fish Toxicology Station.

A. V. Nebeker, D. G. Stevens, and R. K. Stroud. A. V. Nebeker, D. G. Stevens, and R. K. Stroud. Journal of the Fisheries Research Board of Canada, Vol. 33, p 2629-2633, 1976, 2 tab., 5 fig., 8 ref.

Descriptors: \*Sockeye salmon, \*Supersaturation, \*Mortality, \*Lethal limit, \*Fish diseases, Environmental effects, \*Bioassay, \*Saturation, Fish physiology, \*Dams, \*Infection, \*Gases, \*Bubbles, Laboratory tests, Spawning, Fish reproduction, Columbia River.

Identifiers: \*Sublethal effects, \*Gas bubble diseases.

Adult sockeye salmon (*Oncorhynchus nerka*) were exposed to air-supersaturated water in the laboratory from July 8 to August 13, 1974, approximately the same time period that they are exposed to supersaturated water during their movement through the lower and middle sections of the Columbia River. The first mortality occurred after 77 h exposure at 120% saturation; 40% of the fish were dead after 127 h. At 115% saturation the first mortality occurred after 523 h (21 days) and 40% were dead after 835 h (35 days). No further mortality occurred at 120 or 115%. However, emphysema (bubbles) in the mouth, on the gill arches, body surface, and fins, etc. No deaths or signs of gas bubble disease occurred in fish held at 110% saturation in water 2 ft (60 cm) deep. The lethal threshold was near 114% saturation. (Katz) W77-04401

#### SURVIVAL OF COHO SALMON FINGERLINGS PASSING THROUGH OPERATING TURBINES WITH AND WITHOUT PERFORATED BULKHEADS AND OF STEELHEAD TROUT FINGERLINGS PASSING THROUGH SPILLWAYS WITH AND WITHOUT A FLOW DEFLECTOR,

National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.

C. W. Long, F. J. Ossander, T. E. Ruehle, and G.

W. Matthews.

Final Report to U.S. Army Corps of Engineers, Contract No. DACW 68-74-C-0113, February, 1975, 8 p, 3 tab., 5 fig., 2 ref.

Descriptors: \*Supersaturation, \*Salmon, \*Fish passage, \*Mortality, Bioassay, On-site data collection, On-site investigation, \*Dams, Dam sites, Columbia River, \*Hydraulic design, Hydraulic structures, Hydroelectric plants, \*Rainbow trout. Identifiers: Perforated bulkhead, Steelhead fingerlings, Modified spillway, Nitrogen supersaturation, Flow deflectors, \*Coho salmon.

Results of turbine studies imply that perforated bulkheads can be used in operating turbines without causing a higher mortality than would be experienced by fish passing through a standard turbine operation in the range of 105-115%. The addition of flow deflectors to the existing spillways should result in significantly high survival of steelhead that pass through spillways. (Katz) W77-04402

#### GAS-BUBBLE DISEASE DUE TO OXYGEN SUPERSATURATION IN RACEWAY-REARED CALIFORNIA BROWN SHRIMP,

Arizona Univ., Tucson. Environmental Research Lab.

V. C. Supplee, and D. V. Lightner.

The Progressive Fish Culturist, Vol. 138(3), July, 1976, p. 158-159, 1 tab, 9 ref.

Descriptors: \*Shrimp, Commercial shellfish, \*Supersaturation, Oxygen, Diseases, Mortality, Bioassays, Pathology, Behavior, Metabolism, \*Crustaceans.

Identifiers: California Brown Shrimp, \*Gas bubble disease, Oxygen supersaturation, *Penaeus aztecus*, Disease reversal, \*Brown shrimp.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Larval brown shrimp (*Penaeus aztecus*) developed gas bubble disease after being placed in water warmed by a closed heater. In raceways, gas bubble disease was observed when the oxygen saturation of the water exceeded 250%. (Katz) W77-04403

#### EVALUATION OF FISH PROTECTIVE FACILITIES AT LITTLE GOOSE AND LOWER GRANITE DAMS AND REVIEW OF OTHER STUDIES RELATING TO PROTECTION OF JUVENILE SALMONIDS IN THE COLUMBIA AND SNAKE RIVERS, 1975,

National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.

D. L. Park, E. M. Dawley, R. F. Krema, C. W. Long, and E. Slatick.

Report to U.S. Army Corps of Engineers, Contract No. DACW-68-75-C-0111, February, 1976, 50 p., 11 tab., 8 fig.

Descriptors: \*Fish passage, \*Salmon, Supersaturation, \*Mortality, Bioassay, On-site collections, \*On-site investigation, Dams, Dam sites, Columbia River, Hydraulic design, Hydraulic structures, Hydroelectric plants, Rainbow trout, Orifices, Screens, \*Fish migration.

Identifiers: \*Fingerling passage, \*Chinook salmon, Steelhead trout, Fish transport, Fish survival, Modified spillway, Flow deflectors, Snake River.

Vehicle transportation of juvenile salmonids is a positive means of enhancing survival of Snake River outmigrants. There is a significant benefit in hauling smolts in sea water. Spillway deflectors were shown to be instrumental in degassing waters. Traveling screens caused an excessively high descaling rate of fish. Fingerling passage from gatewells was excellent when two eight inch orifices were open. (Katz) W77-04404

#### SURVIVAL OF COHO SALMON FINGERLINGS PASSING THROUGH A PERFORATED BULKHEAD IN AN EMPTY TURBINE BAY AND THROUGH FLOW DEFLECTORS (WITH AND WITHOUT DENTATES) ON SPILLWAY AT LOWER MONUMENTAL DAM, SNAKE RIVER, APRIL-MAY, 1973,

National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.

C. W. Long, and F. J. Ossiander.

Progress Report, U.S. Army Corps of Engineers, March, 1974, 20 p., 2 tab., 8 fig. DACW-68-72-C-0101.

Descriptors: \*Nitrogen, Salmon, Freshwater fish, \*Mortality, Bioassay, On-site data collection, \*On-site investigation, \*Dams, Dam sites, \*Columbia River, Hydraulic design, \*Hydraulic structures, Hydroelectric plants, Dissolved oxygen, Supersaturation, \*Fish passages.

Identifiers: Lower Monumental Dam, Perforated bulkheads, Modified spillways, Nitrogen content, Flow deflectors, \*Coho Salmon, Salmon fingerlings, April-May, 1973.

From tests in 1973, it is concluded that perforated bulkheads and associated water passages cause high mortality to juvenile coho salmon, whereas no losses would be expected for passage of these fish through a spillway bay equipped with plain flow deflectors. (Katz) W77-04405

#### SURVIVAL OF FINGERLING PASSING THROUGH A PERFORATED BULKHEAD AND MODIFIED SPILLWAY AT LOWER MONUMENTAL DAM, APRIL-MAY, 1972,

National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.

C. W. Long, W. M. Marquette, and F. J. Ossiander.

Progress Report, Corps of Engineers, U.S. Army, December 8, 1972, 3 tab., 10 fig. Army, No. DACW68-72-C-0101.

Descriptors: \*Nitrogen, Salmon, Freshwater fish, Mortality, Bioassay, On-site data collection, On-site investigations, \*Dam, \*Dam sites, \*Columbia River, Hydraulic design, Hydraulic gradient, \*Hydraulic structures, \*Hydroelectric plants, Gases, Dissolved oxygen, Supersaturation, Fish passage.

Identifiers: Lower Monumental Dam, Perforated bulkheads, Modified spillway, Nitrogen content, Flow deflector, Chinook Salmon, Fingerlings, 1972.

Perforated bulkheads were installed in intakes of empty turbine bays of dams in the lower river. Deflectors were installed in the spillway area to change the direction of spilling water from plunging to horizontal. Tests with chinook salmon suggest that survival was much higher through the flow deflector than through the perforated bulkhead and associated water passage. (Katz) W77-04406

#### DATA TO SUBSTANTIATE THE PERMISSIBLE CONCENTRATION OF FENURON IN WATER BODIES, (IN RUSSIAN),

Kirgiz Research Inst. of Epidemiology, Microbiology and Hygiene, Frunze (USSR). For primary bibliographic entry see Field 5A. W77-04407

#### DISSOLVED GAS DATA REPORT, 1974, COLUMBIA AND LOWER SNAKE RIVERS,

Army Engineer Div. North Pacific, Portland, Oreg.

For primary bibliographic entry see Field 5A. W77-04408

#### PATHOLOGY OF ACUTE AND CHRONIC EXPOSURE OF SALMONID FISHES TO SUPERSATURATED WATER,

Oregon State Univ., Corvallis. Dept. of Veterinary Medicine.

R. K. Stroud, G. R. Bouck, and A. V. Nebeker. Chemistry and Physics of Aqueous Gas Solutions, 1975, p. 435-449, 8 fig., 26 ref.

Descriptors: Freshwater fishes, \*Nitrogen, Oxygen, \*Animal pathology, Gases, Atmospheric pressure, Atmosphere, Environmental effects, Fish eggs, Fish hatcheries, Fish kills, Toxicity, Mortality, Supersaturation, Salmon, \*Physiological ecology.

Identifiers: Lesions, \*Gas bubble disease, Symptoms of gas bubble disease, Fish pathology, Environmental syndrome, Gas embolisms, Fish fry, Gas supersaturation, Blindness, Adult Chinook Salmon.

Gas Bubble Disease (GBD) is an environmentally caused syndrome occurring in fish. The signs and lesions observed in salmonid fish suffering from GBD result of the formation of macroscopic gas emboli within the circulatory system, emphysema of the tissue and tympanites of the swim bladder. Many factors influence the development of lesions. Excess gas accumulation with the yolk sac and swim bladder of newly hatched fry resulted in abnormal buoyancy. Death of salmonids exposed to acute levels of supersaturation was caused by accumulations of gas emboli in the circulatory system. Emphysema of the fins, opercula, gill arches, body surface, eye sockets, muscle and roof of mouth result from more chronic exposure to gas supersaturation. Excess gas in the choroid plexus resulted in blindness in adult chinook salmon. Fungus and bacterial pathogens invaded tissue devitalized by emphysema. (Katz) W77-04409

#### GAS BUBBLE DISEASE IN FRY OF CHANNEL CATFISH (*Ictalurus punctatus*), Texas A and M Univ., College Station. Dept. of Veterinary Microbiology.

D. Jones, and D. H. Lewis. The Progressive Fish Culturist, Vol. 38(1), January, 1976, p. 41. 1 fig.

Descriptors: \*Fish disease, Animal pathology, \*Fresh water fish, \*Catfish, Fish hatcheries, Fish farming, Fish physiology, \*Supersaturation, Gases, \*Channel catfish, \*Mortalities, Fish kill. Identifiers: Hyperaeration, Channel catfish fry, Loss of equilibrium, \*Gas bubble disease.

Gas bubble disease was observed in channel catfish fry being maintained in intensively aerated water at 22-25°C. (Katz) W77-04410

#### LOWER COLUMBIA AND LOWER SNAKE RIVERS, NITROGEN (GAS) SUPERSATURATION AND RELATED DATA, ANALYSIS AND INTERPRETATION,

Army Engineer Div. North Pacific, Portland, Oreg.

P. E. Boyer.

Contract No. DACW-57-74-C-0146 and DACW 57-75-C-0055, March, 1974, 93 p, 7 appendices, 27 tab., 36 fig.

Descriptors: \*Salmon, \*Columbia River, Bioassay, \*Mortalities, \*Supersaturation, \*Fish passage, On-site data collections, \*Dams, Dam sites, Hydraulic design, Hydraulic structures, Fish migration, Analytical techniques, Water quality, Bioassays, Review.

Identifiers: \*Lower Snake River, Lower Columbia River.

The report and the seven major appendices summarizes the available data regarding the dissolved gas in the Corps of Engineers reservoirs in the Lower Columbia and Lower Snake Rivers. Included is a summary of knowledge regarding the occurrence of nitrogen supersaturation, approach to solutions of the problem, dissolved nitrogen prediction methods, bioassay research, salmon fingerling releases and adult fish returns. (See W77-04412) W77-04411

#### THE EFFECTS OF GAS SUPERSATURATION ON COLUMBIA RIVER FISH RUNS - APPENDIX G,

Army Engineer Div. North Pacific, Portland, Oreg.

W. C. Marshall.

In: Lower Columbia and Lower Snake Rivers, Nitrogen (gas) supersaturation and related data, Contract No. DACW-57-74-C-0146 and DACW-57-75-C-0055, March, 1974, 16 p, 8 fig.

Descriptors: \*Salmon, \*Columbia River, Mortality, \*Supersaturation, \*Fish passage, \*Dams, Dam sites, Fish, \*Fish migration, Water quality, Fisheries, \*Commercial fish, Fish handling facilities, Rainbow trout, Fish populations, Sockeye salmon, Chinook salmon.

Identifiers: Coho salmon, Shad, Fish counts.

An attempt was made to determine if fish count information would allow an estimate of the loss of fish caused directly or indirectly by gas supersaturation. The estimated number of adult fish returning to the Columbia River each year since 1938 has been plotted and the trend established. The number of hatchery releases have been plotted for each available year. (See also W77-04411) (Katz) W77-04412

#### GAS BUBBLE DISEASE, PROCEEDINGS OF A WORKSHOP HELD AT RICHLAND, WASHINGTON, OCT. 8-9, 1974.

Battelle-Pacific Northwest Labs, Richland, Wash.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

Co-sponsored by Battelle, Pacific Northwest Laboratories and U.S. Atomic Energy Comm. Technical Information Center, Office of Public Affairs, Energy Research and Development Administration, Report CONF-741033, 1976, 123 p. D. H. Fickeisen and M. J. Schneider, eds.

Descriptors: Temperature, \*Animal physiology, Salmon, Trout, \*Environment, \*Gases, Water pollution, Fresh water, Sea water, \*Supersaturation, Bioassay, \*Nitrogen, Oxygen, Methodology, \*Power plants, Monitoring, Behavior, Bullheads. Identifiers: Gas bubble disease, Fish pathology, Environmental syndrome, Gas embolism, Steelhead trout, Black bullhead, Blood clotting.

Proceedings of a symposium regarding the biological and other environmental effects of dissolved gas supersaturation in the marine environment are presented. Most of the papers discuss gas bubble disease of fish exposed to supersaturated gases. (See W77-04414 thru W77-04436) (Katz) W77-04413

**EFFECTS OF LONG TERM EXPOSURE TO SUPERSATURATION OF DISSOLVED ATMOSPHERIC GASES ON JUVENILE CHINOOK SALMON AND STEELHEAD TROUT IN DEEP AND SHALLOW TEST TANKS,**  
National Marine Fisheries Service, Seattle, Wash. E. M. Dawley, M. Schiwe, and B. Monk. In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 1-10, 3 tab., 10 fig., 20 ref.

Descriptors: Salmon, Trout, \*Laboratory methods, Methodology, Bioassay, Mortality, \*Supersaturation, \*Gases, Water pollution, \*Animal physiology, Environment, Fishkills, Freshwater, Behavior, Depth, Rainbow trout. Identifiers: Gas bubble disease, Long term exposures, Dissolved atmospheric gases, Fall chinook salmon, Lethal effects.

Bioassays in shallow (0.25 m) and deep (2.5 m) tanks with dissolved atmospheric gas concentrations ranging from 100 to 127% of saturation in water at 10°C were conducted to determine the lethal and sublethal effects on juvenile fall chinook *Oncorhynchus tshawytscha* and steelhead trout *Salmo gairdneri*. Juvenile fall chinook (38.7 to 41.3 mm) were much more resistant to supersaturation than juvenile steelhead (164 to 196 mm). Chinook tested in the shallow tanks at 120% of supersaturation incurred 50% mortality after 22 days, whereas steelhead tested at the same level incurred 50% mortality in 30 hr. Gas bubble disease signs were noted on mortalities and on live subsamples taken every 28 days. Vertical distribution of both chinook and steelhead groups in the deep tanks appeared to compensate for about 10% and 10 to 15%, respectively, of effective supersaturation. Average depths of the fish tested in deep tanks increased with increased gas concentration. Significant differences in growth and condition factor were not found between stressed and control fish during the test period. (See also W77-04413) (Katz) W77-04414

**GAS SUPERSATURATION RESEARCH, NATIONAL MARINE FISHERIES SERVICE PRESCOTT FACILITY - 1971 TO 1974,**  
National Marine Fisheries Service, Seattle, Wash. Environmental Conservation Div. T. H. Blahm, B. McConnell, and G. R. Snyder. In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 11-19, 5 tab., 7 fig., 6 ref.

Descriptors: Water quality, \*On-site laboratories, \*On-site tests, Oregon, Supersaturation, Bioassays, Mortalities, Behavior, Monitoring, Research equipment, Research facility, Salmon, Laboratory methods, Gases, \*Vertical migration, Animal physiology.

Identifiers: Prescott(Ore), National Marine Fisheries Service, Longterm exposures, Dissolved atmospheric gases, Detection of N<sub>2</sub>, Avoidance of N<sub>2</sub>, Gas equilibration characteristics.

In 1969 the NMFS constructed a field facility for 'on-site' environmental testing. The facility is housed on two 110 x 32 foot barges moored on the Columbia River near Prescott, Oregon (RM 72). Research on the effects of nitrogen supersaturation was begun in 1971. Survival is better in the 1.5-m deep tanks than in 1-m deep tanks. Results of tests done in 'shallow' test tanks are not representative of what might occur in the river, as fish are not restricted to 'shallow' depths. Intermittent exposure to high (130, 120, and 110%) and equilibrated (110%) levels of N<sub>2</sub> saturation generally enhanced test fish survival over that recorded for fish held in constant high levels. Preliminary tests indicate that the fish are not able to detect and avoid lethal conditions of supersaturation. Dissolved gas levels have been monitored at Prescott since 1971. (See also W77-04413) (Katz) W77-04415

**EQUIPMENT AND TECHNIQUES FOR MONITORING THE VERTICAL DISTRIBUTION OF FISH IN SHALLOW WATER,**  
National Marine Fisheries Service, Seattle, Wash. Marine, Fish and Shellfish Div. W. Marshall.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 20-23, 10 fig., 2 ref.

Descriptors: \*Methodology, Distance, \*Distribution, Freshwater, \*Monitoring, \*Behavior, Vertical migration, \*Columbia River, Salmon, Trout, Research equipment, Sampling, Laboratory equipment, Laboratory tests.

Identifiers: Recording echo sounder, Fish depth distribution, Lower Columbia River.

A recording echo sounder was modified to scan multiple custom transducers to record to depth distribution of fishes. The system has been used in tanks as well as the Columbia River and eliminates the objections that other sampling methods influence depth distribution. (See also W77-04413) (Katz) W77-04416

**DISSOLVED GAS SUPERSATURATION: LIVE CAGE BIOASSAYS OF ROCK ISLAND DAM, WASHINGTON,**  
Parametric, Inc., Bellevue, Wash. Environmental Services Section. D. E. Weitkamp.

In: Gas Bubble Diseases, Fickeisen, D. H. and M. J. Schneider, Eds. Report CONF-741033, 1976, p. 24-36, 3 tab., 13 fig., 9 ref.

Descriptors: \*On-site investigation, \*On-site laboratories, \*On-site test, \*Bioassay, Salmon, Freshwater, Mortality, Environmental effects, Supersaturation, Columbia River, Methodology, Laboratory equipment, \*Behavior, Animal physiology, Pathology, Nitrogen, Gases.

Identifiers: Vertical distribution, Cumulative mortalities, Rock Island Dam, Dissolved oxygen, Intermittent exposure, Juvenile chinook, Exophthalmia, Hemorrhaging, Fish pathology.

Three live cage bioassays using juvenile chinook salmon (*O. tshawytscha*) were conducted in supersaturated Columbia River water at the Rock Island Dam forebay. The tests of 10 and 20 days' duration utilized volition, specific depth, and intermittent exposure cages which were suspended between the surface and a depth of 4 m. The volition cages extended from the surface to depths of 2, 3, and 4 m. The four specific depth cages were 1 m deep cages suspended at 1 m intervals between the surface and a depth of 4 m. Intermittent exposures were achieved by raising and lowering three 1 m

deep cages in the water column daily to change the actual level of supersaturation experienced by the test fish. A total dissolved gas supersaturation of about 120% in the reservoir water, significant mortalities were encountered only in fish held within 1 m of the surface. Fish held within 2 m of the water's surface for a period of 16 hr per day suffered significant mortalities only when the supersaturation rose to about 125% and above. The effects of supersaturations above about 125% appear to be much greater than supersaturations below this level. Fish allowed to seek the depth of their choice in the 4 m deep volition cage did not suffer mortalities at saturations of 119% and 128%, although some developed gas bubble disease lesions. Most fish showing slight to severe gas bubble disease lesions were able to recover when placed at a depth of 3 to 4 m in the supersaturated water. (See also W77-04413) (Katz) W77-04417

### SUPERSATURATION AND FISHERY OBSERVATIONS IN SELECTED ALPINE OREGON STREAMS,

Corvallis Environmental Research Lab., Oreg. Western Fish Toxicology Station. G. R. Bouck.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds. Report CONF-741033, 1976, p. 37-40, 1 tab., 1 fig.

Descriptors: \*Supersaturation, \*On-site-investigations, \*Freshwater, Mortality, Environmental effects, Water quality, \*Oregon, \*Springs, Oxygen, Nitrogen, Gases, Trout, Invertebrates, Temperature.

Identifiers: Alpine Stream(Ore), Klamath Basin(Ore), Total dissolved gas pressure, Natural supersaturation.

Several Alpine Oregon streams were sampled and found to contain excess levels of dissolved gas tension. Effects of this naturally supersaturated water on hatchery operations and results of sampling of natural populations of aquatic organisms are presented. (See also W77-04413) (Katz) W77-04418

### SOME EFFECTS OF EXCESS DISSOLVED GAS ON SQUAWFISH, PTYCHOCEILUS OREGONENSIS (RICHARDSON),

National Marine Fisheries Service, Seattle, Wash. W. W. Bentley, E. M. Dawley, and T. W. Newcomb.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds. Report CONF-741033, 1976, p. 41-46, 4 tab., 6 fig., 10 ref.

Descriptors: \*Supersaturation, \*Freshwater fish, \*Mortalities, Bioassays, \*Environmental effects, Water quality, Gases, Oxygen, Nitrogen, Toxicity, Laboratory tests, \*Animal physiology, Behavior, Food habits, Predation, Juvenile fish, Migration, On-site-observation.

Identifiers: \*Squawfish, Snake River, Gas bubble disease, Shallow tank bioassays, Tolerance levels, Resistance times, Gas concentration, \*Ptychochilus Oregonensis.

In the spring of 1974, large numbers of squawfish were encountered in the Snake River between Lower Monumental and Little Goose Dams. Squawfish exhibited gas bubble disease symptoms within 1 week after the onset of 125 to 135% saturation. A 12-day bioassay in shallow tanks to determine tolerance levels and resistance times at various gas concentrations was conducted. We found squawfish to be similar to juvenile salmon and steelhead trout in their resistance to supersaturated concentrations of dissolved gas. Feeding response changed after stress to high concentrations of dissolved gas. Average daily food consumption of test groups decreased with increased supersaturation. Squawfish captured in the field during periods of high supersaturation were less abundant and only a small portion of them had

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

been feeding compared with survey results taken during lower supersaturation. Nitrogen supersaturation could be an important factor in assessing the effects of predation on juvenile salmonid migrants in the Columbia River system. (See also W77-04413) (Katz) W77-04419

#### RESPONSES OF COHO SALMON (ONCORHYNCHUS KISUTCH) TO SUPERSATURATION AT ONE ATMOSPHERE, Washington Univ., Seattle. Fisheries Research Inst.

D. Beyer, B. G. D'Aoust, and L. Smith.  
In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 47-50, 1 tab., 3 fig., 4 ref.

Descriptors: \*Salmon, \*Supersaturation, Freshwater fish, Mortalities, \*Animal physiology, Bioassays, Environmental effects, Laboratory animals, Water quality, \*Gases, Oxygen, Nitrogen, \*Bubbles, Methodology, Laboratory equipment.

Identifiers: \*Coho Salmon, Gas bubble disease, Pressure chamber, Decompression, Acute external supersaturation, Bubble formation.

While saturation limits of 110-120% have been established as minimum lethal levels, mortalities may not be entirely related to gas saturation or desaturation rates. To compare maximum saturation times and capacities for inert gas with bubble formation, groups of small coho salmon (60-100 mm) were exposed to supersaturations that were induced either internally (by decompression) or externally (by placing fish in supersaturated water). A minimum of 1 hr at depth was required to obtain maximum lethality from decompression. Assuming maximum lethality was associated with maximum gas absorbed for any given gas pressure, saturation was completed within 60 to 90 min. Thus, the well-documented lethal times of 24 hr or more for an over-saturation of 122% of 1 atm (Meekin and Turner, 1974) indicate a time lag in achieving maximum effect which cannot be related to gas saturation or desaturation rates. The external supersaturations showed that 250 to 500% total gas pressure would result in complete mortality in 10 to 30 min. (See also W77-04413) (Katz) W77-04420

#### EFFECTS OF GAS SUPERSATURATED WATER ON FRESHWATER AQUATIC INVERTEBRATES, Corvallis Environmental Research Lab., Oreg. Western Fish Toxicology Station.

A. V. Nebecker, D. G. Steven, and J. R. Brett.  
In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 51-65, 8 tab., 13 fig., 20 ref.

Descriptors: \*Supersaturation, Gases, \*Invertebrates, \*Daphnia, Trout, Insects, \*Aquatic insects, \*Crayfish, Crustaceans, Toxicity, Mortality, Bioassay, Bubbles, Laboratory animals, Laboratory equipment, Laboratory tests, \*Benthic fauna, \*Stoneflies, Environmental effects, Animal physiology, Rainbow trout.  
Identifiers: Acroneuria, Pteronarcys, Pacifastacus, Salmo, Insect tolerance.

Tests with the stoneflies Acroneuria californica, Acroneuria pacifica, and Pteronarcys californica; Daphnia magna; crayfish (Pacifastacus leniusculus); and young steelhead trout (Salmo gairdneri) were conducted to determine the sensitivity of freshwater insects, crustacea, and fish to gas supersaturated water. Stoneflies and crayfish were tolerant to supersaturation levels, (125%) that killed trout; however, survival was similar in Daphnia and trout. Crayfish died at 150% and 140%; some death and sublethal signs occurred at 130%. Stoneflies were immobilized at 135% and exhibited buoyancy problems at 125%, but were unaffected at 115%. Daphnia were killed at 120%

and exhibited partial mortality at 115%; air in the gut caused food blockage and subsequent starvation. Bubbles were observed in body fluid and tissues, and general body distortion occurred before death in Daphnia, crayfish and stoneflies. The open circulatory system of invertebrates, relatively simple compared to fish, appeared to be the main reason for the greater tolerance of insects and crustacea to gas bubble disease. They do not have the complex capillary blood vessel system of fish which is rapidly blocked by bubbles, or emboli, that form in the blood. (See also W77-04413) (Katz) W77-04421

#### A STUDY OF THE PATHOGENESIS OF GAS BUBBLE DISEASE IN STEELHEAD TROUT (SALMO GAIRDNERI), Oregon State Univ., Corvallis. Dept. of Veterinary Medicine.

R. K. Stroud and A. V. Nebecker.  
In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 66-71, 3 tab., 1 fig., 16 ref.

Descriptors: \*Supersaturation, \*Gases, Trout, Bioassay, Laboratory animals, \*Animal physiology, \*Animal pathology, Mortality, Behavior, Water quality, \*Fish diseases, Laboratory tests, \*Bubbles, Environmental effects, Rainbow trout.  
Identifiers: Supersaturated water, Necropsy, Gas emboli, Emphysema of fins, Opercular emphysema, Exophthalmia, Hemorrhaging, Hemostasis, Cascading bubble effect, \*Gas bubble disease.

Steelhead trout were exposed to supersaturated water and randomly removed for necropsy at predetermined intervals. Lesions included emphysema of fins and opercular, gas emboli, exophthalmia, and hemorrhaging. The hypothesis that death from gas bubble disease is due to hemostasis due to blockage of blood flow by emboli was supported by the necropsy results. A 'cascading bubble effect' is described to explain bubble formation. (See also W77-04413) (Katz) W77-04422

#### EFFECT OF TEMPERATURE ON TOLERANCE TO DISSOLVED GAS SUPERSATURATION OF BLACK BULLHEAD, Ictalurus melas, Battelle-Pacific Northwest Labs., Richland, Wash. Ecosystems Dept.

D. H. Fickeisen, J. C. Montgomery, and R. W. Hart, Jr.  
In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 72-74, 5 fig., 3 ref.

Descriptors: \*Supersaturation, \*Gases, Freshwater fish, Bioassay, Laboratory animals, \*Animal physiology, Mortality, Bioassays, Water quality, Laboratory tests, Bubbles, Catfishes, Bullheads, Statistical methods, Temperature, \*Thermal pollution, \*Columbia River.  
Identifiers: \*Black Bullhead, \*Dissolved gas supersaturation, Supersaturation tolerance, Statistical analysis, Gas bubble disease.

Black bullhead, Ictalurus melas, were acclimated to 8, 12, 16 and 20C in Columbia River water, and were tested at each of the acclimation temperatures to determine acute tolerance to dissolved atmospheric gas tensions in excess of equilibrium saturation. The data were subjected to probit analysis and mean 96-hr TL50 values were 126.7% of equilibrium saturation at 8C, 125.1% at 12C, 123.8% at 16C, and 124.4% at 20C, indicating a slightly elevated tolerance at the lowest test temperature. These values, while indicating a statistically significant difference in tolerance, do not indicate an ecologically significant effect of temperature on acute tolerance of black bullhead in the range of temperatures tested. (See also W77-04413) (Katz) W77-04423

**GAS BUBBLE DISEASE MORTALITY OF ATLANTIC MENHADEN, BREVOORTIA TYRANNUS, AT A COASTAL NUCLEAR POWER PLANT,** Boston Edison Co., Mass. Nuclear Engineering Dept.

R. A. Marcello, Jr., and R. B. Fairbanks.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 75-80, 1 tab., 2 fig., 16 ref.

Descriptors: \*Marine fish, \*Animal pathology, \*Animal physiology, Massachusetts, Atlantic Ocean, \*Atlantic menhaden, \*Supersaturation, Bioassay, Mortality, Laboratory tests, Nitrogen, Dissolved oxygen, Temperature, Methodology, Toxicity, Power plants, Nuclear power plants.

Identifiers: Brevoortia tyrannus, \*Gas bubble disease, Gas bubble disease mortality, Subcutaneous emphysema.

A substantial mortality of Atlantic menhaden, Brevoortia tyrannus, occurred in the discharge channel and discharge plume area of the Boston Edison Company's Pilgrim Nuclear Power Station Unit 1 during the period April 8 through April 24, 1973. Gas bubble disease was implicated as the cause of their death. Measurements of dissolved gas concentration of the station's intake and discharge water during this fish mortality are presented. Observations on the behavior and results of the pathological examination of menhaden afflicted with gas embolism are discussed. (See also W77-04413) (Katz) W77-04424

#### OBSERVATIONS ON THE EFFECTS OF GAS EMBOLISM IN CAPTURED ADULT MENHADEN,

New England Aquarium, Boston, Mass.  
A. Clay, A. Barker, S. Testaverde, R. Marcello, and G. C. McLeod.  
In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 81-84, 1 tab., 3 fig., 4 ref.

Descriptors: Marine fish, \*Animal pathology, \*Animal physiology, Massachusetts, \*Atlantic menhaden, \*Supersaturation, Gases, Bioassay, \*Mortalities, Laboratory tests, Nitrogen, Toxicity, Temperature, Thermal pollution, Salinity, Methodology.

Identifiers: Adult menhaden, Power plant effluents, Gas embolism, Gas bubble disease, New England Aquarium, Histological indices, Gas bubble disease etiology.

The problems of entrapped fish in effluent water of power plants prompted a study of the parameters that induce gas embolism in adult menhaden. Adult menhaden were captured by purse seining in early summer on route to the warmer headwaters of Boston Harbor and maintained in tanks at the New England Aquarium. Supersaturation of the waters in experimental tanks was deliberately induced and the behavior and certain histological indices studied at a range of temperature, salinity, and supersaturation. (See also W77-04413) (Katz) W77-04425

#### GAS BUBBLE DISEASE OF SALMONIDS: VARIATION IN OXYGEN NITROGEN RATIO WITH CONSTANT TOTAL GAS PRESSURE,

National Marine Fisheries Service, Seattle, Wash. Coastal Zone and Estuarine Studies Div.

R. R. Rucker.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p. 85-88, 3 tab., 3 fig., 4 ref.

Descriptors: \*Salmon, \*Dissolved oxygen, \*Nitrogen, Supersaturation, Bioassays, Mortality, Laboratory tests, Methodology, Water properties, Environmental effects, \*Water pollution effects, Gases, \*Animal pathology, Lethal limit.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

Identifiers: \*Coho salmon, \*Gas bubble disease, Oxygen-Nitrogen ratio, Total gas pressures, Salmon fingerlings, Lethal effect, Mortality rate.

Coho salmon fingerlings were subjected to a total gas pressure of 119% at 13.6°C with the O<sub>2</sub>/N<sub>2</sub> varying from 50%/138% to 229%/90%. The small fish (3.8 to 6 cm) were the most resistant and the larger fish (8 to 10 cm) the least resistant to gas bubble disease at the gas concentrations used. A drastic decrease in lethal effect of individual ratios of O<sub>2</sub> to N<sub>2</sub> occurred between 159% O<sub>2</sub>/109% N<sub>2</sub> and 173% O<sub>2</sub>/105% N<sub>2</sub> at the same total gas pressure (119%). (See also W77-04413) (Katz) W77-04426

#### EFFECT OF GAS BUBBLE DISEASE ON LATERAL LINE FUNCTION IN JUVENILE STEELHEAD TROUT,

National Marine Fisheries Service, Seattle, Wash.

M. H. Schiwe, and D. D. Weber.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 89-92, 5 fig, 12 ref.

Descriptors: \*Animal physiology, \*Animal pathology, Trout, \*Rainbow trout, \*Supersaturation, Gases, Oxygen, Dissolved oxygen, Gases, \*Behavior, Bioassay, Mortality, Laboratory animals.

Identifiers: Juvenile trout, \*Gas bubble disease, Lateral line function, Lateral line response, Electrophysiological monitoring, Sublethal effects.

Normal lateral line response of juvenile steelhead trout, *Salmo gairdneri*, to a standardized test of stimuli was compared with the response of fish affected by gas bubble disease. Electrophysiological monitoring of individual afferent nerve fibers showed that as gas emboli formed in the scale pockets of the trunk lateral line of stressed fish, the ability to respond to stimuli was either diminished or completely disappeared. Further testing demonstrated that this sensory loss is reversible and that upon return to equilibrated water, accompanied by the disappearance of the gas emboli, normal function was regained. This sublethal effect of gas bubble disease on the lateral line sensory system may be an important element contributing to indirect mortality. (See also W77-04413) (Katz) W77-04427

#### EFFECTS OF STRESS ON SALMONID BLOOD CLOTTING MECHANISMS,

Washington Univ., Seattle. Coll. of Fisheries.

E. Casillas, L. Smith, and B. G. D'Aoust.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 93-95, 6 fig, 4 ref.

Descriptors: \*Animal pathology, \*Animal physiology, Stress, \*Supersaturation, \*Environmental effects, Freshwater fish, Salmon, Trout, Rainbow trout, Bubbles, \*Fish disease, \*Behavior, Bioassay, Mortalities, Laboratory animals.

Identifiers: Blood clotting, Blood clotting mechanisms, Blood coagulation, Times, Thrombocytes, Hematocrit, Blood plasma glucose, Red blood cells, White blood cells, Pacific salmon.

Enhancement of blood clotting functions is a possible factor which could kill fish following stress resulting from exposure to supersaturation. During examination of various hematological parameters in rainbow trout which were subjected to stress from exercise, blood coagulation times were found to decrease to 45% of the original pre-stress values within a half hour after the termination of the stress period. Thrombocyte counts were found to increase three-to fourfold in the same period. Hematocrits and blood plasma glucose also rose significantly with respect to the stress applied. Red blood cell and white blood cell counts, however, did not increase in response to

the stresser. The degree of responses observed were compared between members of a wild trout population from Chester Morse, Washington, and hatchery-reared Donaldson-strain rainbow trout. The wild strain showed a more rapid return to pre-stress conditions than the hatchery-reared trout. Based on very preliminary experiments, the responses of the clotting mechanisms in Pacific salmon are similar and probably change even more rapidly than in the rainbow trout. This variability in the blood coagulation rate is proposed as a mechanism to avoid disseminated intravascular coagulation (D.I.C) in the poorly perfused muscles of fish. Experiments in this are continuing. (See also W77-04413) (Katz) W77-04428

#### CHANGES IN BLOOD CHEMISTRY OF JUVENILE STEELHEAD, *SMO GAIRDNERI*, FOLLOWING SUBLETHAL EXPOSURE TO NITROGEN SUPERSATURATION,

National Marine Fisheries Service, Seattle, Wash. T. W. Newcomb.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 96-100, 1 fig, 36 ref.

Descriptors: \*Nitrogen, \*Supersaturation, Gases, \*Animal physiology, \*Animal pathology, Bioassay, Environmental effects, Fish disease, Trout, \*Rainbow trout, \*Biochemistry, Argon, Chemical properties, Bioassay.

Identifiers: Gas bubble disease, Sublethal concentration, \*Nitrogen supersaturation.

Groups of juvenile steelhead trout (*Salmo gairdneri*) were exposed for 35 days to various 103, 105, 110, and 116% sublethal nitrogen plus argon saturations. Pooled serum samples were analyzed for Ca, Na, PO<sub>4</sub>, K, Cl, albumin, total protein, cholesterol, alkaline phosphatase, glucose, urea, uric acid, total bilirubin, lactate dehydrogenase, and serum glutamic oxalacetic transaminase. An increase in serum potassium and phosphate, and a decline in serum albumin, calcium, cholesterol, total protein and alkaline phosphatase were noted in steelhead exposed to 116% nitrogen, (N<sub>2</sub>+Ar) saturation (total atmospheric gas saturation 110%). No major changes in blood chemistry were observed at nitrogen saturations of 110% or less. (See also W77-04413) (Katz) W77-04429

#### CONTINUOUS MONITORING OF TOTAL DISOLVED GASES, A FEASIBILITY STUDY,

Cold Regions Research and Engineering Lab., Hanover, N. H.

T. F. Jenkins.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 101-105, 6 fig, 7 ref.

Descriptors: \*Monitoring, \*Supersaturation, \*Water analysis, Gas chromatography, \*Methodology, \*On-site studies, Nitrogen, Oxygen, \*Data collections, Measurement, Laboratory equipment, Gases.

Identifiers: Continuous monitoring, Total dissolved gases, \*Gas bubble disease.

A preliminary investigation was undertaken to determine if a continuous analyzer could be configured to monitor dissolved gases in natural waters. A three-component system was designed consisting of a pumping system, a continuous stripper, and detector. Prototypes of the first two components were assembled and evaluated under field conditions. Based upon these results, it is possible to configure an unattended near-continuous monitor to measure total dissolved gas concentration in natural waters. (See also W77-04413) (Katz) W77-04430

AN ELECTRONIC MONITOR FOR TOTAL DISOLVED GAS PRESSURE,  
Virginia Mason Research Center, Seattle, Wash.

B. G. D'Aoust, R. White, and H. Siebold.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 106-110, 2 fig, 3 ref.

Descriptors: \*Monitoring, \*Supersaturation, \*Water analysis, \*Methodology, Gases, Laboratory equipment, Analytical techniques, Water quality, Water analysis, Testing, Data collection, On-site investigations.

Identifiers: \*Electronic monitoring, \*Dissolved gas pressure, Dissolved gases, Weiss saturometer.

The environmental and biomedical problem of supersaturation of dissolved gas and the research related to it has produced a need for a more efficient means of measuring and monitoring total dissolved gas pressure than those now in use. A modification of the Weiss saturometer is described which equilibrates within 8 min, is portable and can be operated remotely in a recording model. The basic unit is inexpensive, easily constructed out of available components and allows many options in design so that such units can be custom-made to specific needs. It has been field-tested and is currently in use. (See also W77-04413) (Katz) W77-04431

#### BIOLOGICAL STUDIES: LABORATORY ORIENTATION,

Environmental Protection Agency, Corvallis, Oreg.

A. V. Nebeker, and D. H. Fickeisen.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 112-113.

Descriptors: Laboratory studies, Laboratory equipment, Laboratory animals, \*Supersaturation, \*Gases, \*Animal physiology, Animal pathology, Bioassays, Mortality, Bubbles, \*Columbia River, Biochemistry, \*Physiological ecology, Disease resistance, Research priorities, Research equipment, Research and development. Identifiers: Sublethal effects, Chronic effects, Gas bubble disease, Fecundity, Gas supersaturated water, Research needs.

The biological studies which can be performed in the laboratory are needed. It is necessary to determine the lethal levels of gas saturation; the behavior of fish subjected to gas supersaturation; the depth selection behavior of fish subjected to gas supersaturation; the rate of equilibration of animals and the aquatic media and the effects of intermittent exposure to supersaturated water. Knowledge is also required regarding the sublethal and chronic effects, combined stressor effects, gas bubble formation trigger mechanisms, and detection of response by fish to gas supersaturation. (See also W77-04413) (Katz) W77-04432

#### BIOLOGICAL STUDIES: FIELD ORIENTATION,

National Marine Fisheries Service, Seattle, Wash. W. Ebel, and R. McConnell.

In: Gas Bubble Disease, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 114-115.

Descriptors: On-site investigations, Research and development, Research priorities, \*Supersaturation, \*Gases, Bioassays, Laboratory animals, Animal physiology, Animal pathology, Freshwater fish, \*Salmon, Trout, \*Columbia River, \*Fish migration, \*Fish passage. Identifiers: Gas bubble disease, Sublethal effects, Chronic effects, Gas supersaturated waters, Spillway deflectors, Sublethal exposures.

Research studies should be continued on methods of transporting fish. Survival studies should be ob-

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

tained to determine the efficiency of spillway deflectors. Horizontal and vertical distribution data for both salmonid and resident species are required and additional data are needed on the tolerance of adult salmonids to supersaturation. Also needed are long term studies of sublethal exposure on survival and productivity. The synergistic effects of other factors on tolerance to supersaturation are unknown. (See also W77-04413) (Katz) W77-04433

**ANALYTICAL METHODS,**  
Battelle-Pacific Northwest Labs., Richland, Wash. Ecosystems Dept.  
M. J. Schneider, and B. G. D'Aoust.  
In: *Gas Bubble Disease*, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 116-117, 1 ref.

**Descriptors:** \*Gases, \*Supersaturation, \*Analytical techniques, \*Gas chromatography, Water quality, \*Water analyses, Monitoring, Data collection, Water quality standards, Water chemistry, Water quality control.  
**Identifiers:** Gas bubble disease, Dissolved gas, Dissolved gas quantification.

The methods for measuring gas concentrations are the Weiss saturometer, the microgasometric method of Scholander and the Van Slyke manometric method and gas chromatography. A need for convenient methods for measuring gases is required and a technique of continuous monitoring devices is needed. (See also W77-04413) (Katz) W77-04434

**PHYSICS OF DISSOLVED GASES AND ENGINEERING SOLUTIONS,**  
Army Engineer District, Walla Walla, Wash.  
G. C. Richardson, and R. Baca.  
In: *Gas Bubble Disease*, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 118-119.

**Descriptors:** \*Supersaturation, \*Gases, \*Engineering, Engineering structures, Entrainment, Mixing, Deflection, Storage, Storage requirements, Transportation, \*Spillways, Model studies, Hydraulic models, \*Columbia River, Salmon, Trout.  
**Identifiers:** Gas bubble disease, Degasification, Nitrogen supersaturated water, \*Dissolved gas supersaturation, Spillway deflectors, Transportation of salmonids.

Physics and engineering research needs in regard to gas bubble disease should include the study of processes of entrainment and supersaturation in stilling basins. Mitigation activities should include engineering procedures such as upstream storage reservoir and spillway deflectors. (See also W77-04413) (Katz) W77-04435

**WATER QUALITY STANDARDS,**  
Environmental Protection Agency, Seattle, Wash.  
R. L. Rulifson, and R. Pine.  
In: *Gas Bubble Disease*, Fickeisen, D. H. and M. J. Schneider, Eds., Report CONF-741033, 1976, p 120.

**Descriptors:** \*Supersaturation, Gases, \*Nitrogen, \*Behavior, \*Fish physiology, Fish pathology, Benthos, Invertebrates, Fresh water fish, \*Salmon, Trout, Standards, \*Water quality standards, Water quality, Law enforcement, Methodology, Columbia River.  
**Identifiers:** Total dissolved gas supersaturation, 115% supersaturation, Juvenile salmonids, Enforcement levels.

One hundred fifteen per cent of gas supersaturation is recommended as an acceptable criteria for the protection of juvenile salmonids from direct

lethal effects. More knowledge of the depth distribution of salmonids is required. One hundred ten per cent saturation should be adopted as a criteria for protection of shallow water benthos. (See also W77-04413) (Katz) W77-04436

### RESOURCE AND LITERATURE REVIEW, DIS-SOLVED GAS SUPERSATURATION AND GAS BUBBLE DISEASE, 1975,

Parametrix, Inc., Bellevue, Wash. Environmental Services Section.

D. E. Weitkamp, and M. Katz.  
Report submitted to Northwest Utility Cooperative, Idaho Power Company, Boise, Idaho, Document No. 75-0815-042FR, August, 1975, 71 p, 72

**Descriptors:** \*Reviews, \*Bibliographies, \*Publications, \*Salmon, Trout, \*Columbia River, Water pollution, Freshwater bioassay, Nitrogen, Oxygen, Power plants, Behavior, Dam, Damsites, Animal physiology, \*Methodology, On-site studies, Laboratory animals, Laboratory tests, \*Environmental effects, \*Supersaturation, Chinook salmon, Rainbow trout.  
**Identifiers:** \*Gas bubble disease, Dam design, Environmental syndrome, Gas embolism.

A review of available published and unpublished literature that deals with the effects of water characterized by supersaturation of dissolved gases on fish and aquatic organisms. Emphasis is on literature published since 1970 through 1975 and greater insights into the more complex aspects of the problem are presented. (See also W77-04438) (Katz) W77-04437

### RESOURCE AND LITERATURE REVIEW, DIS-SOLVED GAS SUPERSATURATION AND GAS BUBBLE DISEASE,

Parametrix, Inc., Bellevue, Wash. Environmental Services Section.

D. E. Weitkamp, and M. Katz.  
Report submitted to Northwest Utility Cooperative, Idaho Power Company, Boise, Idaho, October 1973, 60 p, 116 ref.

**Descriptors:** \*Reviews, \*Bibliographies, \*Publications, \*Salmon, \*Supersaturation, Columbia River, Temperature, Trout, Gases, Water pollution, Fresh water, Bioassay, Nitrogen, Oxygen, Power plants, Behavior, Dams, Damsites, Dam design, Dam construction.  
**Identifiers:** \*Gas bubble disease, Fish pathology, Environmental syndrome, Gas embolism, Steelhead, Trout.

A review of the available published and unpublished literature that deals with the effects of water characterized by supersaturation of dissolved gases on fish and other aquatic organisms. Particular emphasis is placed on publications that apply to the Snake and Columbia River Systems. (See also W77-04437) (Katz) W77-04438

### MORTALITY, SALTWATER ADAPTATION AND REPRODUCTION OF FISH DURING GAS SUPERSATURATION,

Corvallis Environmental Research Lab., Oreg. Western Fish Toxicology Station.  
G. R. Bouck, A. V. Nebeker, and D. G. Stevens.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-253 777, Price codes: A04 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA-600/3-76-050, May, 1976, 55 p, 12 tab, 11 fig, 24 ref.

**Descriptors:** \*Temperature, \*Animal physiology, \*Salmon, Trout, Environment, Gases, Water pollution, Fresh water, \*Supersaturation, Bass, Bioassay, Fresh water fishes, \*Nitrogen, Oxygen, Atmospheric pressure, Methodology, Mortality.

Animal pathology, Fishkills, Sea, Sea water, Laboratory methods.

**Identifiers:** \*Gas bubble disease, Gas bubble disease symptoms, Fish pathology, Environmental syndrome, Gas embolism, Fish fry, \*Gas supersaturation, Salmon life stages, Gas bubble disease pathology.

Tests were conducted using continuous exposure in shallow water at levels of total dissolved gas pressure ranging from 110-140% of barometric pressure (hyperbaric pressure = 103-410 g/cm<sup>2</sup>). Both times to 20% and to median mortality were determined on several life stages of Pacific salmonids (*Oncorhynchus* and *Salmo*) and Largemouth bass (*Micropterus salmoides*). Mean times to 20% mortality at 155% total gas saturation were 309, 154, and 125 hours for adults, smolts and parr. At 120% saturation mean times to 20% mortality were 48, 41, 53 hours for adults, smolts and parr. At 125% saturation, mean times to 20% mortality decreased to 18, 17, and 24 hours for adults, smolts and parr. Factors which influenced time to death included genera, life stage, acclimation temperature, activity level, sex and body size. Mortality curves were typically skewed to the right. Gross pathology of gas bubble disease was described relative to these experiments. High gas levels that killed 50% of three species of salmon smolts had no apparent effect on the ability of the survivors to tolerate an immediate transfer into seawater (30 ppt C1). Long-term (3-month) continuous exposure of adult spring chinook salmon to 110% saturation had no readily apparent adverse impact on the fertilization and hatching of their eggs. (Katz) W77-04439

### SALMONID BIOASSAY OF SUPERSATURATED DISSOLVED AIR IN WATER,

National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.

E. Dawley, B. Monk, M. Schiweie, F. Ossian, and W. Ebel.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-256 413, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency, Ecological Research Series, EPA-600/3-76-056, July 1976, 39 p, 4 tab, 10 fig, 23 ref.

**Descriptors:** \*Animal physiology, \*Salmon, Trout, \*Pathology, Freshwater, \*Bioassay, Toxicity, Mortality, \*Supersaturation, \*Nitrogen, Laboratory animals, Laboratory tests, Behavior, Growth, Rainbow trout, Chinook salmon.  
**Identifiers:** \*Dissolved atmospheric gas, Juvenile fall chinook salmon, Resistance, \*Gas bubble disease.

Tests were conducted in shallow (.25 m) and deep (2.5 m) tanks of water at 10C with concentrations of dissolved atmospheric gas ranging from 100 to 127% of saturation to determine the lethal and sublethal effects of the dissolved gas on juvenile fall chinook salmon, *Oncorhynchus tshawytscha*, and steelhead trout, *Salmo gairdneri*. Fall chinook salmon (average fork length of 42 mm) were much more resistant to supersaturation than juvenile steelhead trout (average fork length of 180 mm). Salmon tested in the shallow tanks at 120% of saturation incurred 50% mortality after 22 days whereas trout tested at the same level, incurred 50% mortality in 30 hrs. Signs of gas bubble disease were noted on dead fish and on sub-samples of live fish from deep water tests at 110% saturation and above and in shallow water tests at 105% and above. Vertical distribution of both salmon and trout in the deep tanks appeared to compensate for about 10% and 10 to 15% respectively of effective saturation. Average depths of the fish in deep tanks increased with increased gas concentration. Significant differences in growth and condition factor of the salmon and trout were not found between stressed and control fish during the test period. (Katz) W77-04440

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## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

#### EFFECTS OF CONTROLLED SPILLING AT CHIEF JOSEPH DAM ON DISSOLVED NITROGEN SUPERSATURATION IN THE COLUMBIA RIVER, Washington Dept. of Fisheries, Olympia.

T. K. Meekin, and R. L. Allen.

In: Nitrogen Supersaturation Investigations in the Mid-Columbia River, Washington Department of Fisheries, Technical Report 12, 1974, p. 1-31, 15 tab., 1 fig., 3 ref., 2 appendices.

Descriptors: \*Columbia River, \*Water quality, Freshwater, Dams, Dam sites, \*Nitrogen, On-site investigations, Dam design, Dam construction, Hydraulic structure, \*Supersaturation, \*Grand Coulee Dam, Hydroelectric Plants, Oregon.

Identifiers: Chief Joseph Dam, Spill conditions, \*Dissolved nitrogen supersaturation.

The effect of spilling at Chief Joseph Dam on the downstream dissolved nitrogen saturation levels was tested in 1971 and 1972. Spill conditions tested ranged from an average of 20,300 cfs to 205,600 cfs in 1971 and from no spill to an average of 199,900 cfs in 1972. A wide variability of nitrogen saturation levels in Chief Joseph forebay occurred during the 1971 tests. This was attributable to variable spills occurring at Grand Coulee Dam. The testing demonstrated that spilling at Chief Joseph Dam increased the downstream nitrogen saturation levels when the forebay was near equilibration. Spill values of 60,000 cfs increased the tailrace value by approximately 10% while spills of 100,000 cfs or higher increased the saturation by about 20%. Spill volumes in the magnitude of 30,000 cfs or less did not increase the nitrogen levels, however, the forebay was never at equilibration when tests were conducted at these lower flows. When the forebay was saturated at levels of 120% or higher, spills of about 200,000 cfs did not significantly increase the downstream nitrogen levels. (Katz) W77-04441

#### NITROGEN SATURATION LEVELS ON THE MID-COLUMBIA RIVER, 1965-1971, Washington Dept. of Fisheries, Olympia.

T. K. Meekin and R. L. Allen.

In: Nitrogen Supersaturation Investigations in the Mid-Columbia River, Washington Department of Fisheries, Technical Report 12, 1974, p. 32-77, 21 tab., 11 fig., 7 ref.

Descriptors: \*Columbia River, \*Grand Coulee Dam, Water quality, Fresh water, \*Dams, Dam sites, Nitrogen, On-site investigations, Hydraulic structure, Hydroelectric plants, Water control, Overflow, On-site data collection, \*Supersaturation.

Identifiers: 1965-1971, Lake Roosevelt, Grand Coulee Forebay, \*Nitrogen saturation, Nitrogen supersaturation, Nitrogen equilibration.

Columbia River water at the Rocky Reach spawning channel during March 1965 was found to be supersaturated with dissolved nitrogen gas. Subsequent testing in May 1965 showed the Columbia River to be supersaturated from Grand Coulee Dam downstream to Rooster Rock Park, about 18 miles below Bonneville Dam. This report presents the results of nitrogen analysis, primarily in the mid-Columbia River, from 1965 through 1971. The Grand Coulee forebay (Lake Roosevelt) was found to be supersaturated with nitrogen during the 2 years it was tested, 1965 and 1971. Spilling at Grand Coulee Dam increased the nitrogen saturation of the Columbia River to levels of 120% to 130% during periods of heavy spill. The resulting nitrogen levels do not completely equilibrate in transit through the downstream reservoirs. The effect of the next dam downstream is to generally maintain the nitrogen levels. Spilling at Priest Rapids, and Rocky Reach Dams generally decreased tailrace nitrogen levels when forebay levels were 120% or greater. During non-spill periods, the Columbia River equilibrates to the 100% saturation level. (Katz) W77-04442

#### TOLERANCE OF SALMONID EGGS, JUVENILES AND SQUAWFISH TO SUPERSATURATED NITROGEN, Washington Dept. of Fisheries, Olympia.

T. K. Meekin, and B. K. Turner.

In: Nitrogen Supersaturation Investigations in the Mid-Columbia River, Washington Department of Fisheries, Technical Report No. 12, p. 75-126, 15 tab., 9 fig., 18 ref.

Descriptors: \*Salmon, Freshwater fish, Bioassays, Mortalities, \*Fish eggs, \*Nitrogen, Animal physiology, \*Pathology, \*Supersaturation, Laboratory tests, Behavior, Adaptation, Fish eggs, On-site tests, Columbia River, Water quality.

Identifiers: Nitrogen content fluctuations, Squawfish, Egg mortalities, Juvenile mortalities, Gas bubbles, Gas bubble disease, Chinook salmon, Dissolved nitrogen.

Bioassays were conducted on several species of salmonid eggs and juveniles and squawfish to investigate their tolerance to varying levels of supersaturated nitrogen. The majority of the tests were conducted in shallow troughs with oxygen saturations of less than 100%. Additional tests were conducted with live cages in the Columbia River. The results showed that species of juvenile salmonids tested can withstand prolonged exposure to concentrations of 112% dissolved nitrogen gas with few mortalities occurring. Depth was shown to be a compensating factor when nitrogen supersaturation is present. Large juveniles of the species tested will succumb to nitrogen in less exposure time than smaller fish. Bubbles (emboli) are the most common external symptoms of nitrogen gas. Juveniles exposed to the lethal levels and succumbing in short exposure periods did not always show external symptoms. Squawfish can tolerate levels of 120% saturation but will not actively feed at this level. (Katz) W77-04443

#### SUMMER CHINOOK AND SOCKEYE SALMON MORTALITY IN THE UPPER COLUMBIA RIVER AND ITS RELATION TO NITROGEN SUPERSATURATION, Washington Dept. of Fisheries, Olympia.

T. K. Meekin, and R. L. Allen.

In: Nitrogen Supersaturation Investigations in the Mid-Columbia River, Washington Dept. of Fisheries, Technical Report 12, 1974, p. 127-153, 2 tab., 9 fig., 8 ref.

Descriptors: \*Columbia River, \*Salmon, \*Mortalities, Fishkills, Nitrogen, \*Supersaturation, On-site investigations, Mortalities, Water quality, Freshwater fish, Fish reproduction, \*Hydroelectric dams, Damsites, Sockeye salmon, Chinook salmon.

Identifiers: Chief Joseph Dam, Gas monitoring, \*Supersaturated nitrogen gas, Mortality estimates.

Pre-spawning mortality of adult summer chinook (*Oncorhynchus tshawytscha*) and sockeye (*Oncorhynchus nerka*) salmon was first observed in the upper Columbia River, downstream from Chief Joseph Dam, in 1965. During the same year, the Columbia River was found to be supersaturated with nitrogen gas. Boat searches and aerial reconnaissance flights were conducted from 1965 through 1970 to estimate the extent and cause of the mortality. Samples of Columbia River water were analyzed during the same period to monitor the levels of supersaturated nitrogen gas. The mortality was estimated by using a carcass tagging-recovery study in 1967 and a spawning fish per redd factor of 3.1:1 from 1968-1970. The estimated mortalities were 59.3% of the Wells Dam summer chinook escapement in 1967, 44.3% in 1968, 55.6% in 1969 and 5.5% in 1970. The evidence indicated that supersaturated nitrogen is caused by spilling at the Columbia River dams and is associated with significant mortalities of fish life. From 1965 through 1968, considerable numbers of floating salmon carcasses were found in the river. These

carcasses coincided in timing with spilling and nitrogen levels in excess of 120%. During 1970, few floater carcasses were found, spilling was reduced from previous years both in time and volume, and fish were not subjected to levels higher than 117%. (Katz) W77-04444

#### THE PRESENT AND FUTURE OF COASTS.

Coastal Society, Bethesda, Md.

For primary bibliographic entry see Field 2L.

W77-04462

#### CLEANER: THE LAKE GEORGE MODEL, Rensselaer Polytechnic Inst., Troy, N.Y. Fresh Water Inst.

For primary bibliographic entry see Field 6G.

W77-04495

#### PHYTOPLANKTON MODELS AND EUTROPHICATION PROBLEMS, Manhattan Coll., Bronx, N.Y. Environmental Engineering and Science Program.

D. J. O'Connor, D. M. Di Toro, and R. V. Thomann.

In: Ecological Modeling in Resource Management Framework (Ed. by Clifford S. Russell), p 149-209, Resources for the Future, Inc., Washington, D.C., July 1975. 21 fig., 1 tab, 7 ref.

Descriptors: \*Phytoplankton, \*Eutrophication, \*Mathematical models, \*Water quality control, Equations, Seasonal, Distribution, Rivers, Lakes, Evaluation, Alternative planning, Lake Erie, Lake Ontario, Kinetics, Zooplankton, Nitrogen, Phosphorus, Estuaries, \*Simulation analysis, Systems analysis, Sewage treatment, Treatment facilities, Recreation, Nutrients, Water policy, California.

Identifiers: San Joaquin River (Cal), Potomac River, Transport structures.

The primary purpose of this paper is to present the applications of a set of equations which describe the seasonal distribution of phytoplankton to the analysis of eutrophication problems in various locations throughout the country. A brief review of the theoretical structure of the analysis is presented with a qualitative description of the pertinent equations and a discussion of the general procedure of the verification process. Examples from various natural water systems are presented to demonstrate the utility of this type of analysis in evaluating alternative plans to restore or maintain appropriate levels of water quality. The systems considered are: (1) the fresh water segment of the San Joaquin River; (2) the estuarine regions of the Sacramento-San Joaquin Delta; (3) the Potomac River; (4) Western Lake Erie; and (5) Lake Ontario. The individual studies cited herein contain complete bibliographies of the scientific and engineering literature which was used in the analysis of the general problem and the development of the equations. Specific applications included prediction of the effect of water diversions and increased nutrient discharges on phytoplankton populations wherein estimates of the effect of alternative policies regarding both diversions and required sewage treatment levels are considered. (See also W77-04493) (Bell-Cornell) W77-04499

#### FISH POPULATION MODELS: POTENTIAL AND ACTUAL LINKS TO ECOLOGICAL MODELS, National Marine Fisheries Service, Beaufort, N.C. Atlantic Estuarine Fisheries Center.

For primary bibliographic entry see Field 6G.

W77-04500

#### ENVIRONMENTAL TOXICITY OF AQUATIC RADIONUCLIDES: MODELS AND MECHANISMS, Rochester Univ., N.Y.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. 333 p. Edited by Miller, M. W. and Stannard, J. N.

**Descriptors:** \*Environmental effects, \*Conferences, \*Toxicity, \*Radiotopes, Aquatic environment, \*Model studies, Measurement, \*Path of pollutants, Testing, Water pollution effects, Radioactivity, Radiation, Radioactivity effects.

The proceedings consist of fourteen papers on the general topic of environmental toxicity with sections on biochemistry of the transurans in aqueous environments (6 papers), modeling and measurements (3 papers), model testing (3 papers), and general ecological studies (2 papers). Also included is the record of a panel discussion, an author index, and a subject index. (See W77-04509 thru W77-04522)  
W77-04508

#### EFFECTS OF RADIATION ON AQUATIC POPULATIONS,

Battelle-Pacific Northwest Labs., Richland, Wash.

W. L. Templeton.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 287-301, 22 ref.

**Descriptors:** \*Environmental effects, \*Radiation, \*Aquatic populations, Nuclear energy, Populations, Genetics, Water pollution effects, Radioactivity effects.

The potential effects of radiation on aquatic populations are evaluated. Dose rates considered are within the ranges which either exist or may potentially exist in the aquatic environment as a result of the expansion of the use of nuclear energy. Data indicates that even though some stages of individual organisms are sensitive to radiation, the dose rates required are many times higher than present rates even at major disposal sites. It was concluded that populations of highly fecund species are unlikely to be perturbed by present levels of radiation from controlled disposal to the marine environment. However, for species of low fecundity where the reproductive success of the individual is more important to the overall success of the population, some decrease in chances of survival may exist with additional stresses. (See also W77-04508) (Chilton-ONRL)  
W77-04509

#### THE DISTRIBUTION OF TRANSURANIC ELEMENTS IN A FRESHWATER POND ECOSYSTEM,

Battelle Pacific Northwest Lab., Richland, Wash. Ecosystems Dept.

R. M. Emery, and D. C. Klopfer.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 269-285, 4 tab, 3 fig, 21 ref. ERDA DBER 000834.

**Descriptors:** \*Environmental effects, \*Ecosystems, Freshwater, Ponds, \*Plutonium, Americium, Distribution, Food web, Path of pollutants, Eutrophication. **Identifiers:** \*Transuramics, \*Americium.

A freshwater waste pond which had received small amounts of plutonium processing wastes since 1944 was studied for a period of two years. The pond represented an ultra-eutrophic ecosystem. The principal repository of plutonium and americium was the sediments but seston was the most active concentrator of these transuramics. Organic floc covering the pond's bottom was the primary food source and a major concentrator. Mean levels of plutonium and americium ranged from 3 to 5

fCi/ml during mid-summer, whereas mean Pu and Am concentrations in the sediments and floc ranged from 80 to 1000 pCi/gm. Of the biotic components in the pond, non-filamentous algae were the main concentrators, having mean concentrations of from 100 to 140 pCi/g. Submergent macrophytes accumulated levels of 50 to 100 pCi/g. Other food web components had levels which were lower. (See also W77-04508) (Chilton-ONRL)  
W77-04510

#### THE DOSIMETRIC IMPLICATIONS OF RELEASES TO THE AQUATIC ENVIRONMENT FROM THE NUCLEAR POWER INDUSTRY,

New York Univ. Medical Center, N.Y. Inst. of Environmental Medicine.

M. E. Wrenn, and S. M. Jinks.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 229-265, 15 tab, 5 fig, 42 ref.

**Descriptors:** \*Environmental effects, \*Radioactivity effects, \*Human population, Aquatic environment, Nuclear energy, Nuclear powerplants, Radium, Radioisotopes.

Dosimetric implications are evaluated in terms of the average per capita doses to substantial population groups associated with fuel cycle facilities. The nuclides considered include the natural radionuclides of uranium and radium-226 and the artificial nuclides Cs 137, 134, Sr 90, I 131, Co 60, Mn 54, and H3. Fuel cycle activities include mining and milling, fuel fabrication, power generation, and fuel reprocessing. The most important doses are associated with milling and result from Ra226 in the order of one to ten mrem/yr. Per capita doses to substantial populations from nuclear power plants may be roughly equal from H3 and Cs137 on the order of 0.01 mrem/yr on Lake Michigan. Potential per capita exposure for Cs137 via fish may be 1 mrem/yr on rivers and some smaller lakes. All doses are less than 10% of total natural background. (See also W77-04508) (Chilton-ONRL)  
W77-04511

#### RADIOCESIUM TRANSPORT IN THE HUDSON RIVER ESTUARY,

New York University Medical Center, N.Y. Inst. of Environmental Medicine.

For primary bibliographic entry see Field 5B.

W77-04512

#### PLUTONIUM-237 AND -246: THEIR PRODUCTION AND USE AS GAMMA TRACERS IN RESEARCH ON PLUTONIUM KINETICS IN AN AQUATIC CONSUMER,

Oak Ridge National Lab., Tenn. Environmental Science Div.

L. D. Eymann, J. R. Trabalka, and F. N. Case.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 193-206, 3 fig, 2 tab, 14 ref.

**Descriptors:** \*Environmental effects, \*Plutonium, Radiochemical analysis, Aquatic animals, Fish, \*Radioisotopes, Kinetics, Gamma rays, \*Tracers, Path of pollutants.

**Identifiers:** Gamma emitters.

Pu 237 and Pu 246 were used in investigations of the uptake, retention and tissue distribution of monomeric plutonium(IV) in channel catfish. These gamma emitting isotopes of plutonium appear to be a viable tool in research dealing with the mechanisms which mediate the kinetics of this element in natural systems. Whole-body retention was 1.9% of ingested dose for Pu237. This gas-

trointestinal tract accounted for 46% of the body burden at 30 days post-administration. Less than 10% of the intracardially injected plutonium-citrate was excreted. Blood clearance rate was comparable to previous studies on small mammals. A comparison of the two isotopes indicated that Pu 237 has greater utility for environmental research. (See also W77-04508) (Chilton-ONRL)  
W77-04513

#### THE COLLOIDAL NATURE OF RADIONUCLIDES IN SEAWATER,

Rochester Univ., N.Y. Dept. of Radiation Biology, and Rochester Univ., N.Y. Dept. of Biophysics.

For primary bibliographic entry see Field 5B.

W77-04514

#### MEASUREMENTS FOR MODELING RADIONUCLIDE TRANSFER IN THE AQUATIC ENVIRONMENT,

Georgia Inst. of Tech. Atlanta. Environmental Resources Center.

For primary bibliographic entry see Field 5B.

W77-04515

#### A SYSTEMS ANALYSIS MODEL FOR CALCULATING RADIONUCLIDE TRANSPORT BETWEEN RECEIVING WATERS AND BOTTOM SEDIMENTS,

Oak Ridge National Lab., Tenn. Environmental Sciences Div.

For primary bibliographic entry see Field 5B.

W77-04516

#### AMERICIUM IN THE MARINE ENVIRONMENT-RELATIONSHIPS TO PLUTONIUM,

Woods Hole Oceanographic Institution, Mass.

H. D. Livingston, and V. T. Bowen.

In: Environmental Toxicity of Aquatic Radionuclides: Model and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 107-130, 3 tab, 5 fig, 18 ref. E(11-1)-3563.00.

**Descriptors:** \*Environmental effects, \*Plutonium, Seawater, Sediments, Biota, Path of pollutants.

**Identifiers:** \*Americium, \*Marine environment.

Radiochemical data for nuclides of plutonium, americium, curium and heavier elements in seawater, sediments, and organisms were used to generate the ratio Am 241/Pu 239, 240. This ratio was used as an index of fractionation between plutonium and americium. It was concluded that Am isotopes may sink in association with particles more rapidly than plutonium nuclides and hence be transferred more rapidly to the sediments. Indications are that, at least for the near shore regions, both transplutonic elements and plutonium may be remobilized from sediments and be available to organisms. Data suggest that some organisms may discriminate for or against americium relative to plutonium. (See also W77-04508) (Chilton-ONRL)  
W77-04517

#### THE BEHAVIOR OF PLUTONIUM NUCLIDES IN THE IRISH SEA,

Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.

J. A. Hetherington.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 81-106, 9 fig, 4 tab, 30 ref.

**Descriptors:** \*Environmental effects, \*Plutonium, \*Radioisotopes, Sediments, Seawater, Sedimentation, Oceans, Pollutant identification.

**Identifiers:** \*Irish Sea.

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## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

Plutonium discharges from the nuclear fuel element reprocessing plant at Windscale in Cumbria to the north-eastern Irish Sea are discussed. It was found that 95% of the plutonium introduced into the sea was rapidly lost from the water phase to the sediments and that the residual fraction which remains in solution appears to behave in a manner similar to Cs 137. The ratio of Pu 238:Pu 239 with depth in core samples confirms the conclusion that sedimentation of material which became contaminated while in suspension is the primary mechanism by which nuclides are incorporated into the sediments of the area. (See also W77-04508) (Chilton-ORNL)  
W77-04518

**THE BEHAVIOR OF PLUTONIUM IN AQUATIC ECOSYSTEMS: A SUMMARY OF STUDIES ON THE GREAT LAKES,**  
Argonne National Lab. Ill. Radiological and Environmental Research Div.  
D. N. Edgington, M. A. Wahlgren, and J. S. Marshall.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 45-79, 14 fig, 8 tab, 30 ref.

Descriptors: \*Environmental effects, \*Plutonium, \*Aquatic environment, Ecosystems, \*Great Lakes, Water, Biota, Sediments, Trophic levels, \*Lake Michigan.

Data on the concentration of plutonium in water, biota, and sediments from the Great Lakes during the period from 1972 to 1974 are summarized. It was found that, despite variations in new fallout inputs, 97% of the Pu239, 240 and Cs 137 in Lake Michigan water have decreased slightly during the time period. Annual variations in the concentration of plutonium in surface water is attributed to sorption by phytoplankton and subsequent plutonium from water with a concentration factor of near 5000 and an order of magnitude drop in the concentration factor is seen with each higher trophic level so that the concentration in piscivores is nearly the same as in water. The depositional pattern of plutonium in sediments is related to the hydrodynamic properties of the lake. (See also W77-04508) (Chilton-ORNL)  
W77-04519

**PLUTONIUM FOODCHAINS,**  
Helsinki Univ., Finland. Dept. of Radiochemistry.  
J. K. Miettinen.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 29-43, 4 tab, 3 fig, 20 ref. ERDA CH E(11-1)-3011.

Descriptors: \*Environmental effects, \*Plutonium, \*Food chains, Marine algae, Fish, Sediments, Gulfs.  
Identifiers: \*Gulf of Finland.

Pu 238, Pu 239, and Pu 240 were investigated in the terrestrial foodchain lichen-reindeer-man and in the aquatic foodchain bottom sediment-benthic fauna-fish. Coastal marine samples from the Gulf of Finland showed that fish contained 0.04-0.14 pCi/kg fresh wt, brown algae contained 5 pCi/kg fresh wt, and sediment contained 0.18 nCi/kg in the top centimeter. It was concluded that the Pu239, 240 in samples from the Gulf of Finland were comparable with those from the Great Lakes in the U.S. Forms of the lower trophic levels contained more plutonium than the higher trophic levels since the foodchains seem to lead to reduction. The sediment value from the Baltic was similar to that from the North Atlantic, but the fish values were considerably higher. (See also W77-04508) (Chilton-ORNL)  
W77-04520

**TRANSURANIC STUDIES IN THE MARINE ENVIRONMENT,**  
Energy Research and Development Administration, Washington, D.C. Div. of Biomedical and Environmental Research.

W. O. Forster.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 11-27, 7 tab, 2 fig, 5 ref.

Descriptors: \*Environmental effects, Research and development, \*Radioisotopes, Aquatic environment, Plutonium.  
Identifiers: Marine environment, \*Transuramics.

Research programs sponsored by ERDA-DBER over the past few years are reviewed. Opposing views on the need for research in the area of transuranic cycling in the marine environment are discussed with attention given to NAS-ACDA study on the marine effects of all-out nuclear war. Possible source terms derived from national defense oriented activities, from civilian energy-related activities which involve whole fuel cycle losses, extrapolations to the time when the breeder is current technology, and from ERDA service-oriented activities are summarized. The paper also discusses the importance of the specific activity concept when dealing with various isotopes of plutonium and the significant chemical reactions of plutonium in aqueous solution. It is concluded that the ionic potential concept may allow some predictive power for marine mobilities of various physical-chemical forms of transuramics. (See also W77-04508) (Chilton-ORNL)  
W77-04521

**TOWARD A GLOBAL MONITORING PROGRAM FOR TRANSURANICS AND OTHER MARINE POLLUTANTS,**  
Scripps Institution of Oceanography, La Jolla, Calif.

E. D. Goldberg.

In: Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, Proceedings of the 8th Rochester International Conference on Environmental Toxicity, 1975. p 3-10, 6 ref.

Descriptors: \*Monitoring, \*Radioisotopes, \*Water pollution, Pollutants, Heavy metals, Oil, Organic compounds, Halogenated pesticides, Environmental effects, Measurement, Mussels.

Identifiers: Sentinel organisms, Barnacles.

Four collectives of pollutants which may pose threats to natural waters were identified as the natural radioactive nuclides produced as a consequence of energy production, the halocarbons, petroleum, and heavy metals. Several factors indicate the need for continuing and systematic surveillance of pollutants in coastal marine waters. The present work suggests that mussels and barnacles are especially attractive as sentinel organisms for the purpose of measuring the exposure levels of these pollutants. It is estimated that the costs of collection, shipment, storage, distribution and analysis of 100 samples could be underwritten for less than \$300,000. (See also W77-04508) (Chilton-ORNL)  
W77-04522

**THE EARLY LIFE HISTORY OF FISH, VOLUME II.**

For primary bibliographic entry see Field 21.  
W77-04524

**NUTRITION DE LA LARVE DE TURBOT (SCOPHTHALMUS MAXIMUS L.) AVANT LA METAMORPHOSE,**  
Centre Oceanologique de Bretagne, Brest (France).  
M. Girin.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 739-746, 2 fig, 4 ref.

Descriptors: \*Fish farming, \*Growth, Larval growth stage, Foods, Food abundance, Mortality, Fish food organism.

Identifiers: \*Turbot.

Seven batches of turbot larvae were reared in 60 l translucent perspex tanks at 21°C for 20 days and fed first with the rotifer Brachionus plicatilis and then with nauplii of the crustacean Artemia salina. Eggs were obtained through artificial spawning and incubated in hatching baskets or strongly aerated circular tanks. The day after hatching the larval concentration ranged from 15 to 50/l. The rotifer was offered over a period of 7-9 days and the crustacean over 13-15 days. The best results were about 20% survival on the 20th day. This was obtained with 3 Brachionus/ml offered on the 2nd day, an average daily ration of 160 Brachionus/larva from the 2nd to 9th day, and 175 Artemia nauplii/larva from the 6th to 19th day. (See also W77-04524) (Chilton-ORNL)  
W77-04526

**LABORATORY REARING OF COMMON SOLE (SOLEA SOLEA L.) UNDER CONTROLLED CONDITIONS AT HIGH DENSITY WITH LOW MORTALITY,**

Bayerische Landesanstalt fuer Fischerei, Sternberg (West Germany).

J. Flucher.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 725-730, 3 fig, 1 tab, 7 ref.

Descriptors: \*Fish farming, \*Laboratories, Growth chambers, Growth stages, Fish, Foods, Food abundance, Mortality.  
Identifiers: \*Sole.

Sole larvae were reared at densities of 100/l. First feeding and survival rate were observed to depend upon the presence of certain members of the microfauna. Three types of survival were seen: (1) good development to the healthy young-fish stage, (2) no feeding on Artemia nauplii when first feeding should start, followed by a total mortality, (3) high percentage feeding when Artemia first offered followed by a later high mortality. It was concluded that there is a dissolved organic substance that sole larvae require. Small crustaceans, ciliates, and algae may extract this from the seawater more efficiently than sole, being better competitors for the substance. (See also W77-04524) (Chilton-ORNL)  
W77-04528

**ARTIFICIAL INSEMINATION IN TROUT USING A SPERM DILUANT,**

Institut National de la Recherche Agronomique, Jouy-en-Josas (France). Laboratoire de Physiologie des Poissons.

For primary bibliographic entry see Field 21.  
W77-04529

**THE ABILITY OF HERRING AND PLAICE LARVAE TO AVOID CONCENTRATIONS OF OIL DISPERSANTS,**  
Aberdeen Univ. (Scotland). Dept. of Natural History.

K. W. Wilson.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 589-602, 7 fig, 18 ref.

Descriptors: \*Environmental effects, \*Water pollution, Behavior, \*Fish behavior, Larvae, \*Herrings, Oil pollution, \*Oil wastes, Vertical migration, Seawater.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Identifiers: \*Plaice.

The responses of larvae of herring and plaice to horizontal gradients of oil dispersants in sea-water were studied using a five-channel fluvirian which maintained a stable gradient at right angles to the direction of flow. The mean distributions of plaice tended to the clean water channel at all concentration gradients. Changes in distribution of plaice appeared to be the result of an orthokinetic response and not a chemotaxis. Herring larvae showed no avoidance of vertical gradients but remained in the dispersant layer until they became narcotized, sank into clean water and recovered, only to swim into the dispersant layer again. It was concluded that larvae would not avoid areas of dispersant at sea but because of the effects of dispersants would sink or swim away from lethal concentrations. (See also W77-04524) (Chilton-ORNL)  
W77-04539

#### CHANGES IN BEHAVIOR DURING STARVATION OF HERRING AND PLAICE LARVAE, Dunstaffnage Marine Research Lab., Oban (Scotland).

J. H. S. Blaxter, and K. F. Ehrlich.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland May 17-23, 1973. p 575-588, 10 fig, 3 tab, 22 ref.

Descriptors: \*Environmental effects, \*Behavior, \*Fish behavior, Larvae, Herrings, Feeding rates, Buoyancy, Weight, Biochemistry, Larval growth stage.

Identifiers: \*Starvation, Plaice.

The behavior of herring and plaice larvae changes during starvation, with the critical stage (point-of-no-return or PNR) being the point at which 50% of larvae are able to feed. The time taken to reach the PNR varies from 6 days at the end of the yolk-sac stage in both species to about 15 days in older larvae. Later it takes 3-4 weeks to reach PNR. During starvation there is a progressive decrease in sinking rate due to an increase in hypotonic body water and a decrease in body protein. Only when larvae become moribund does osmoregulation fail and the larvae dehydrate and start to sink. Vertical migration in response to changes of light intensity continues beyond the PNR but there is a reduction in the number migrating and in their activity levels after a few days of starvation. There was no evidence for activity failing to compensate for lack of food. (See also W77-04524) (Chilton-ORNL)  
W77-04540

#### EFFECT OF PREY DISTRIBUTION AND DENSITY ON THE SEARCHING AND FEEDING BEHAVIOR OF LARVAL ANCHOVY ENGRAULIS MORDAX GIRARDI,

National Marine Fisheries Service, La Jolla, Calif. Southwest Fisheries Center.

J. R. Hunter, and G. L. Thomas.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973 p 559-574, 8 fig, 3 tab, 18 ref.

Descriptors: \*Environmental effects, \*Behavior, Fish behavior, Larvae, Larval growth stage, Prey fish, Predation, Distribution, Density. Identifiers: \*Feeding behavior, Prey densities, Prey distribution, Anchovy, Engraulis mordax.

Searching and feeding behavior of larval anchovy were studied under conditions of high aggregation of prey and at various densities when prey were not highly aggregated. The prey used in most experiments was the dinoflagellate, Gymnodinium splendens, the rotifer, Brachionus plicatilis, was used in comparative studies. Yolk-sac and post-yolk-sac larvae were present in patches in conditions of both light and dark. The number of larvae

attracted to a patch depended upon the density and volume of the patch. The structure of searching behavior at various prey densities was analyzed by recording movements of larvae as they swam over a grid. Speed and direction of search patterns of larvae were density-dependent: larvae swam faster at low prey densities than they did at higher ones; and the expected area covered by a larva on the basis of directional components alone was greater at low densities. (See also W77-04524) (Chilton-ORNL)  
W77-04541

#### VITAL ACTIVITY PARAMETERS AS RELATED TO THE EARLY LIFE HISTORY OF LARVAL AND POST-LARVAL LAKE WHITEFISH (COREGONUS CLUPEAFORMIS), Virginia Inst. of Marine Science, Gloucester Point, W. J. Hoagman.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland May 17-23, 1973. p 547-558, 1 fig, 5 tab, 22 ref.

Descriptors: \*Behavior, \*Fish behavior, \*Environmental effects, Growth stages, Larval growth stage, Larvae, Temperature, Light, Feeding rates, Swimming.

Identifiers: \*Feeding behavior, Whitefish.

Larval lake whitefish hatched in nature were transported to constant environmental conditions and experimented on over fish sizes of 12.6 to 24.9 mm. Swimming speed while feeding on live plankton was 1.5 cm/sec and did not increase proportional to size. Sustained swimming ability increased from 3.7 to 11.4 cm/sec and maximum short distance speed increased from 6.7 to 22.6 cm/sec proportionally with size. Body lengths per second averaged 3.7 times the body length. Young whitefish were non-schooling and fed independently at an effective feeding rate of 37.8% of all encounters with copepods. Feeding ceased during absolute darkness. Food intake and activity was continuous, enabling larvae to search between 8.1 h and 14.5 1/h. Temperature preference was 12-17 C when acclimation temperatures were 6, 11, and 14.5 C. Avoidance temperatures were 20-23C with heat narcosis and death above 24 C. Temperature preference did not change with size. Light gradients from 2475-1 lux had no concentrating effects except on the smallest sizes. Vertical distributions in the laboratory were epilagic. (See also W77-04524) (Chilton-ORNL)  
W77-04542

#### GYNOGENESIS IN HYBRIDS WITHIN THE PLEURONECTIDAE,

Ministry of Agriculture Fisheries and Food, Lowestoft (England).

C. E. Purdom, and R. F. Lincoln.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 537-544, 3 tab, 10 ref.

Descriptors: \*Genetics, \*Environmental effects, Temperature, Irradiation, Breeding, Embryonic growth stage, Fish genetics, Fish.

Identifiers: \*Gynogenesis, \*Plaice, \*Flounder, \*Halibut.

Hybrids between plaice or flounder and halibut (using spermatozoa of halibut) were shown to be haploids arising by gynogenesis. Cold shocks given within 20 min after fertilization produced diploid embryos and larvae of maternal appearance. Irradiation of halibut spermatozoa with Co60 gamma rays at a dose of 100,000 rad did not affect the patterns of fertilization and subsequent embryonic development. Hybrids between flounder and plaice showed only 10% of embryos which looked abnormal and haploid-like but the frequency of these did not differ between cold-shocked and non-cold-shocked eggs. These abnor-

malities were not caused by haploidy. Physical attributes of halibut spermatozoa could not be invoked to explain the lack of fusion of halibut spermatozoan genetic material. (See also W77-04524) (Chilton-ORNL)  
W77-04543

#### ARTIFICIAL GYNOGENESIS AND ITS APPLICATION IN GENETICS AND SELECTIVE BREEDING,

Bureau of Sport Fisheries and Wildlife, Stuttgart, Ark. Fish Farming Experiment Station.

J. G. Stanley, and K. E. Sneed.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland May 17-23, 1973. p 527-536, 1 fig, 1 tab, 41 ref.

Descriptors: \*Genetics, Fish genetics, Breeding, Irradiation, Reproduction, Chromosomes, Carp, Fish.

Identifiers: \*Gynogenesis, Ctenopharyngodon idella, Carassius auratus.

Gynogenesis is identified as potentially valuable for providing unisex populations, in genetic studies and selective breeding for locating and selecting recessive genes and in studies of chromosome linkage and crossovers. The grass carp was used as a test animal. Gynogenetic fry were produced by treating eggs with x-irradiated goldfish sperm. A total of 185 embryos hatched of which 34 were presumed diploid out of 40,000 eggs which had received a 2 C temperature shock. No embryos were found in controls. Offspring produced by gynogenesis could theoretically reproduce if the female of the species had heterogametic sex chromosomes or if spontaneous sex inversions occur. It was concluded that production of gynogenetic fishes offers a means for stocking exotic species without the likelihood of reproduction. (See also W77-04524) (Chilton-ORNL)  
W77-04544

#### INFLUENCE OF TEMPERATURE AND SALINITY ON EMBRYONIC DEVELOPMENT, LARVAL GROWTH AND NUMBER OF VERTEBRAE OF THE GARFISH, BELONE BELONE,

Nederlandse Instituut voor Onderzoek der Zee, Texel.

M. Fonds, H. Rosenthal, and D. F. Alderdice.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland May 17-23, 1973. p 509-525, 7 fig, 6 tab, 35 ref.

Descriptors: \*Environmental effects, \*Temperature, \*Salinity, \*Growth stages, \*Embryonic growth stage, Larval growth stage, Larvae, Fish, \*Cars.

Identifiers: Belone belone.

Of the two environmental factors examined, temperature appears to have a predominant influence on eggs of garfish during incubation. Survival of eggs during incubation and of larvae reared to 40-44 mm total length appears to be maximized at salinity-temperature conditions of approximately 31-37% S and 17.5-19.5 C. Length and weight of reared larvae, and larval condition, appear to be optimized in the same approximate range. Body size of newly-hatched larvae is maximized, and yolk-sac size is minimized, by exposure during incubation to below 10% S at temperature near 14C. Number of vertebrae is estimated to be minimum after incubation to salinity-temperature levels at or near 41% S and 21C. (See also W77-04524) (Chilton-ORNL)  
W77-04545

#### EFFECTS OF REDUCED OXYGEN ON EMBRYOS AND LARVAE OF THE WHITE

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## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

#### SUCKER, COHO SALMON, BROOK TROUT, AND WALLEYE.

Environmental Research Lab.-Duluth, Minn.

R. E. Siebert, and W. A. Spoer.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 487-495, 4 tab, 15 ref.

Descriptors: \*Environmental effects, \*Oxygen, Fish, Growth stages, Eggs, Larvae, \*Book trout \*Salmon, \*Suckers, \*Walleye.

The effects of continuous-reduced dissolved oxygen concentrations were on the embryos and larvae of the species studies from egg fertilization until the larvae were feeding. White suckers and walleyes were not harmed at 50% saturation but white sucker development was inhibited at 25% saturation and walleye survival dropped sharply at 35% saturation. Developmental delay and mortality of coho salmon increased progressively with each reduced oxygen concentration tested including the highest reduced tension of 50% saturation. Some slight delays of brook trout development occurred at all reduced oxygen tensions tested, but marked effects on development and poor survival occurred only at 20% saturations and below. (See also W77-0424) (Chilton-ORNL)

W77-04547

#### TEMPERATURE TOLERANCE OF EARLY DEVELOPMENT STAGES OF DOVER SOLE, SOLEA SOLEA (L.).

Ministry of Agriculture, Fisheries and Food, Port Erin (England). Fisheries Lab.

D. N. Irvin.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 449-463, 7 fig, 3 tab, 24 ref.

Descriptors: \*Environmental effects, \*Temperature, \*Growth stages, Eggs, Larvae, Resistance, Mortality, Fish, Thermal stress.

Identifiers: \*Dover sole, *Solea solea*.

Temperature tolerance of *S. solea* was found to increase during ontogeny. Embryonic stages were notably stenothermal in relation to the generally eurythermal larval stages, though tolerance continued to increase during larval development up to the period of metamorphosis. Successful full-term incubation of Stage 1A eggs was predictable between 7 and 16°C but successful first-feeding of larvae hatched from these eggs was only obtained over a narrower range of 12-16°C. Larvae hatched at 13°C and transferred to temperature of up to 22°C commenced first-feeding. 96-h LC50 values of 23, 24, and 28. 1°C were derived for upper lethal limits of yolk-sac larvae, first-feeding larvae, and methamorphosing larvae respectively. For Stage 5 larvae, the absolute tolerance range was found to be 20-23°C. (See also W77-04524) (Chilton-ORNL)

W77-04549

#### EFFECTS OF CONSTANT AND RISING TEMPERATURES ON SURVIVAL AND DEVELOPMENT RATES OF EMBRYONIC AND LARVAL YELLOW PERCH, PERCA FLAVESCENS (MITCHILL).

Environmental Research Lab.-Duluth, Minn.

K. E. F. Hokanson, and C. F. Kleiner.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 437-448, 5 fig, 2 tab, 16 ref.

Descriptors: \*Environmental effects, \*Temperature, \*Mortality, \*Growth rates, Eggs, Hatching, \*Yellow perch, Growth stages, Fish.

Thermal tolerance of successive embryonic and larval stages of yellow perch increased with

morphological differentiation. Survival of early embryonic stage (before neural keel) was generally favored at 3.1 to 19.9°C. The optimal thermal regime for culture of yellow perch was an initial exposure of fertilized eggs to 10°C and exposure to 20°C before hatching. Rising temperature regimes also favored shorter hatching periods and lower incidence of abnormalities at hatch. Mass hatch occurred in 6 day at 19.7°C and in 15 days at 5.4°C. Effects of incubation temperatures on total hatch, median time to hatch, and size at mass hatch of *Perca flavescens* were compared to *P. fluviatilis* and the data tend to support the theory that the two may be conspecific. (See also W77-04524) (Chilton-ORNL)

W77-04550

#### EFFECT OF PARENTAL TEMPERATURE EXPERIENCE ON THERMAL TOLERANCE OF EGGS OF MENIDIA AUDENS.

Texas Univ., at Austin, Dept. of Zoology.

C. Hubbs, and C. Bryan.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 431-435, 2 fig, 1 tab, 3 ref.

Descriptors: \*Environmental effects, \*Thermal stress, Fish, Eggs, Temperature, Resistance, Mortality.

Identifiers: Parental experience, \*Silversides, *Menidia audens*.

Thermal tolerance of eggs of the silverside, *Menidia audens*, is shown to be influenced by prior temperature experience of the parent. A 9 degree C difference in parental acclimation temperature resulted in an upward shift in thermal tolerance of eggs from the higher of two parental acclimation groups. This shift, measured in terms of the thermal range at which gastrulation would occur, was of the order of 1 degree C. When the thermal stress was maintained after gastrulation, a reversal occurred. Eggs exposed to sublethal thermal stresses and returned to optimal temperatures showed high survival, despite being subjected to two thermal shocks in such transfers. (See also W77-04524) (Chilton-ORNL)

W77-04551

#### EFFECT OF HYDROGEN SULFIDE ON DEVELOPMENT AND SURVIVAL OF EIGHT FRESHWATER FISH SPECIES.

Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.

L. L. Smith, Jr. and D. M. Oseid.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 417-430, 11 tab, 11 ref.

Descriptors: \*Environmental effects, \*Water pollution, \*Hydrogen sulfide, Fish, Eggs, Fry, Mortality, Resistance, Freshwater, Brook trout, Rainbow trout, Trout, Pikes, Walleye, Suckers.

Identifiers: \*Fathead, Goldfish, Bluegill.

The eggs fry of 8 species of North American freshwater fish were subjected to concentrations of hydrogen sulfide varying from 0.006 - 0.086 mg/l. In general, survival was reduced, fry length at hatch shortened, and dry deformity increased with increasing hydrogen sulfide concentration. Treatment of fish of some species prior to spawning reduced fecundity and egg survival. Low oxygen concentration increased resistance of fry but decreased resistance of eggs. The no-effect levels of hydrogen sulfide were lower than acutely toxic levels as described by median lethal concentrations. Levels of hydrogen sulfide commonly found in natural systems may inhibit or prevent reproduction of some fish species. It was concluded that many habitats with unexplained absence of satisfactory fish reproduction should

be examined for possible natural contamination with hydrogen sulfide in potential spawning and nursery area. (See also W77-04524) (Chilton-ORNL)

W77-04552

be examined for possible natural contamination with hydrogen sulfide in potential spawning and nursery area. (See also W77-04524) (Chilton-ORNL)

W77-04552

#### RESISTANCE OF PLAICE EGGS TO MECHANICAL STRESS AND LIGHT.

Deutsche Akademie der Wissenschaften zu Berlin (East Germany). Institut fuer Meereskunde.

T. Pommeranz.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 397-416, 20 fig, 1 tab, 41 ref.

Descriptors: \*Environmental effects, \*Stress, \*Resistance, Light, Eggs, Larvae, Mortality, Fish.

Identifiers: \*Mechanical stress(Fish), \*Plaice.

Mortality caused by deformation from crushing forces was found to decrease considerably during development. Due to combination of different viability with varying mechanical resistance to deformation, the eggs pass through an extremely vulnerable phase during the first hours after fertilization; a second phase with low viability but with high mechanical resistance after the activation until the embryo has surrounded half of the yolk's circumference; a third optimal phase with high viability and high mechanical resistance; and a final phase with a decrease of the mechanical resistance immediately before hatching. By means of a spray, bubbling and surfing water the eggs were also exposed to shearing forces. Only a few eggs could not tolerate these but yolk sac larvae were relatively susceptible to the spray. Artificial ultraviolet light was not very harmful but artificial infrared light sometimes caused a high mortality. The lethal effect of natural daylight was thought to be due to the ultraviolet component. The tolerance limit of eggs in 9.5 cm deep containers lay between 257 ly/d and 462 ly/d and 462 ly/d above the natural insulation during the spawning season. (See also W77-04524) (Chilton-ORNL)

W77-04553

#### EFFECTS OF CADMIUM ON DEVELOPMENT AND SURVIVAL OF HERRING EGGS.

Biologische Anstalt Helgoland (West Germany).

H. Rosenthal, and K. R. Sperling.

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 383-396, 5 tab, 7 fig, 27 ref.

Descriptors: \*Environmental effects, \*Cadmium, Mortality, \*Eggs, \*Herrings, Larvae.

Herring eggs from Baltic spring and autumn spawners were incubated at different concentrations of cadmium in solutions containing cadmium-EDTA, cadmium-zinc, and cadmium ascorbic acid. Percentage of viable hatch was 16.3% in 1.0 ppm Cd, 82.7% in 0.1 ppm Cd, and 93.0% in control samples. In a concentration of 5.0 ppm Cd no viable occurred. With increasing Cd concentrations, larvae had smaller size and longer yolk sacs. The effect of Cd was diminished in the presence of zinc and EDTA. Cadmium uptake took place mainly at the surface of the egg capsule, causing a change in the physico-chemical properties of the chorion. The ionic form of cadmium in sea water is important for the action of the toxicity mechanism. (See also W77-04524) (Chilton-ORNL)

W77-04554

#### SURVIVAL OF AUSTRALIAN ANCHOVY (ENGRaulis australis) EGGS AND LARVAE IN A HEAT TRAP.

Trent Univ., Peterborough (Ontario).

P. M. Powles.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

In: Proceedings of an International Symposium on the Early Life History of Fish held at the Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 373-381, 5 fig, 2 tab, 16 ref.

Descriptors: \*Environmental effects, \*Temperature, Thermal stress, Larvae, Larval growth stage, Eggs, Mortality, Cooling water, Australia, Thermal pollution. Identifiers: \*Australian anchovy, *Engraulis australis*, Critical Thermal Maximum, CTM.

The Australian anchovy spawns in sea bays and estuaries from September to February with vast numbers of the eggs passing through cooling condensers of steam electric stations. At Vales Point, on Lake Macquarie, N. S. W., it was found that survival of late eggs from inlet and discharge canals was 90% and 60%, respectively in November and December, but only 30% when discharge canal temperatures rose above 32°C in January and February. Part of this mortality could be due to turbulence and/or abrasion in the collecting net. The Critical Thermal Maximum (CTM) for both anchovy and triggerfish was found to be between 37 and 40°C. (See also W77-04524) (Chilton-ORNL) W77-0455

#### EFFECTS OF THERMAL SHOCK ON LARVAL ESTUARINE FISH-ECOLOGICAL IMPLICATIONS WITH RESPECT TO ENTRAINMENT IN POWER PLANT COOLING SYSTEMS

National Marine Fisheries Service, Beaufort, N. C. Atlantic Estuarine Fisheries Center.

D. E. Hoss, W. F. Hettler, Jr. and L. C. Coston.

In: Proceedings of an International Symposium on the Early Life History of Fish held at Dunstaffnage Marine Research Laboratory, Oban, Scotland, May 17-23, 1973. p 357-371, 5 tab, 6 fig, 17 ref. AT(49-7)-5.

Descriptors: \*Environmental effects, \*Thermal stress, Larval growth stage, Larvae, Fish, Temperature, Salinity, Metabolism, Respiration, Behavior, Fish behavior, Mortality, Atlantic menhaden, Powerplants, Cooling water, Fish handling facilities, \*Entrainment.

Critical thermal maximum (CTM), oxygen consumption, survival, and behavior of larval fish were measured as a function of the magnitude of temperature change, exposure time, and salinity for larvae of Atlantic menhaden, spot, pinfish, and 3 species of flounder. Measurements of CTM were useful in establishing ranges of thermal tolerance but were inadequate for evaluating the effects of entrainment on larval fish. Data indicated that metabolic increases were temporary with return to normal after a few hours in surviving fish. Survival was dependent on magnitude of temperature change, length of exposure, salinity, and species of fish. Loss of equilibrium was observed not only after increases in temperature but also after decreases in temperature to ambient. Equilibrium loss may cause fish to be more vulnerable to predation. (See also W77-04524) (Chilton-ORNL) W77-04556

#### BIOLOGICAL ACTION OF NITRATES IN DRINKING WATER, (IN RUSSIAN)

Kazanskii Gosudarstvennyi Meditsinskii Institut (USSR). Inst. of Public Hygiene.

For primary bibliographic entry see Field 5A.

W77-04560

#### BEHAVIOR OF FISH INFLUENCED BY HOT-WATER EFFLUENTS AS OBSERVED BY ULTRASONIC TRACKING

Institute of Freshwater Research, Drottningholm (Sweden).

L. Nyman.

Fishery Board of Sweden, Institute of Freshwater Research Report No. 54, p. 63-74, 1975. 7 fig., 19 ref.

Descriptors: \*Thermal pollution, \*Fish behavior, \*Monitoring, \*Data collections, Telemetry, Heated water, Foreign countries, Nuclear powerplants, Water temperature.

Identifiers: \*Ultrasonic tracking, Sensors, Sweden.

To study effects of above-normal temperatures on fish, standard and thermistor-equipped ultrasonic tags were inbedded in the stomachs of ide, silver and yellow eels and sea-run brown trout (*Salmo trutta*) and traced with hydrophones/sonic receivers. The purpose of the study was to determine responses to heated effluents from a nuclear power station and a fossil fuel thermal powerplant on the east and west coasts of Sweden, respectively. No typical behavior or irritation from the tags was noted and tag shedding was not a great problem. Ide were attracted by heated water only in autumn but only for a short period; net avoidance was also observed. Yellow eels were attracted by heated discharges in summer, and although silver eels were activated and attracted in winter at 7-10 centigrade, they were repelled in late summer and autumn, their principal migration period. Brown trout were attracted by heated water when ambient sea temperatures did not exceed 15-16 centigrade and avoided heated areas in summer. The study proved the feasibility of using ultrasonic telemetry for studying the behavior of fish exposed to heated plumes and demonstrates its potential as an aid for recreational and commercial fishermen, and possibly as a tool to evaluate the effects of thermal power plant siting in relation to fish fauna. (Auen-Wisconsin) W77-04568

#### PIKE AS THE TEST ORGANISM FOR MERCURY, DDT AND PCB POLLUTION. A STUDY OF THE CONTAMINATION IN THE STOCKHOLM ARCHIPELAGO

Naturhistoriska Riksmuseet, Stockholm (Sweden).

M. Olsson, and S. Jensen.

Fishery Board of Sweden, Institute of Freshwater Research Report No. 54, p. 83-106, 1975. 8 fig., 13 tab., 45 ref., 1 append.

Descriptors: \*Bioindicators, \*Pikes, \*Mercury, \*DDT, \*Polychlorinated biphenyls, Biomass, Fish, Weight, Analytical techniques, DDE, Water pollution sources, Chlorinated hydrocarbon pesticides, Foreign countries, Pollutant identification.

Identifiers: \*Bioaccumulation, \*Stockholm archipelago (Sweden).

According to a study of effluent-laden waters outside Stockholm, Sweden, the widely-distributed pike has advantages among fish as a test organism for bioaccumulating pollutants because of its stationary habits, growth throughout its lifetime, and weight approximates age for each sex. Furthermore, local variation in growth is moderate, and important consideration when mercury levels for a standardized weight of the fish are used in comparing different localities. (For DDT and polychlorinated biphenyls, mean sample levels can be used). Pike have a considerable lifespan and a long mercury half-life, an advantage during investigations into the general distribution pattern of an area where currents and winds vary. Since it is a predatory fish the levels of the pollutants studied may depend on the degree of accumulation in the food species. However, the levels of the accumulated substances in organisms are influenced by the degree of biological activity and biomass; thus if two equal volumes of water, one with a high and the other with a low biomass, are exposed to an equal amount of a substance, the highest level per unit weight organic matter will be in the low biomass sample. Methods and analytical techniques for determining distribution, amounts, and sources of mercury, DDT and PCB in the Stockholm archipelago and two island lakes are also given. (Auen-Wisconsin) W77-04571

#### AQUATIC PLANTS: A GUIDE FOR THEIR IDENTIFICATION AND CONTROL IN PENNSYLVANIA

Pennsylvania Water Resources Coordinating Committee, Harrisburg.

For primary bibliographic entry see Field 5G.

W77-04570

#### AN EXAMINATION OF THE POSSIBLE EFFECTS OF SUDBURY NICKEL MINING AND SMELTING OPERATIONS ON FISHES AND THE WATER CHEMISTRY OF LAKES WITHIN THE WHITEFISH LAKE INDIAN RESERVE

Fisheries and Marine Service, Nanaimo (British Columbia). Biological Station.

R. J. Beamish, G. A. McFarlane, J. C. VanLoon, and J. Lichwa.

Technical Report No. 579, 1975. 56 p. 13 fig., 7 tab., 66 ref.

Descriptors: \*Water pollution effects, \*Water pollution sources, \*Acidity, \*Mine wastes, \*Heavy metals, \*Precipitation(Atmospheric), \*Canada, Nickel, Fish, Water chemistry, Sulfates, Indian reservations, Potable water, Oxides, Copper, Zinc, Manganese, Cadmium, Fallout, Air pollution, Industrial wastes.

Identifiers: Whitefish Lake Indian Reserve(Ontario), Sudbury(Ontario), Sulfur oxides, La Cloche Mountain lakes(Ontario).

The Sudbury operations represent Canada's greatest single source of sulfur dioxide, releasing 2.6 million tons into the atmosphere annually with approximately 14,500 tons of iron, 2000 tons of nickel, and 1800 tons of copper. The heavy metals and oxides are precipitated both by rain and as dry fallout. To evaluate effects of these pollutants, water chemistry was measured in lakes within the Whitefish Lake Indian Reserve and in the La Cloche Mountains, southwest of the reserve but in the same direction of the prevailing winds. Lakes along the southeast edge of the reserve had pH values below 6.0, with one at a value of 4.5. Acid concentrations in the La Cloche Mountain lakes were harmful to aquatic life and fish, as were the abnormally-high concentrations of metals, particularly nickel. While concentrations were not directly harmful to fish, chronic acidity effects on sensitive organisms were evidenced by reduced reproduction. The most acidic lake contained no fish. Waters on the north boundary of the reserve were heavily contaminated for all parameters tested, with some heavy metal concentrations exceeding internationally-accepted limits for drinking water. (Auen-Wisconsin) W77-04571

Descriptors: \*Bioindicators, \*Pikes, \*Mercury, \*DDT, \*Polychlorinated biphenyls, Biomass, Fish, Weight, Analytical techniques, DDE, Water pollution sources, Chlorinated hydrocarbon pesticides, Foreign countries, Pollutant identification.

Identifiers: \*Bioaccumulation, \*Stockholm archipelago (Sweden).

According to a study of effluent-laden waters outside Stockholm, Sweden, the widely-distributed pike has advantages among fish as a test organism for bioaccumulating pollutants because of its stationary habits, growth throughout its lifetime, and weight approximates age for each sex. Furthermore, local variation in growth is moderate, and important consideration when mercury levels for a standardized weight of the fish are used in comparing different localities. (For DDT and polychlorinated biphenyls, mean sample levels can be used). Pike have a considerable lifespan and a long mercury half-life, an advantage during investigations into the general distribution pattern of an area where currents and winds vary. Since it is a predatory fish the levels of the pollutants studied may depend on the degree of accumulation in the food species. However, the levels of the accumulated substances in organisms are influenced by the degree of biological activity and biomass; thus if two equal volumes of water, one with a high and the other with a low biomass, are exposed to an equal amount of a substance, the highest level per unit weight organic matter will be in the low biomass sample. Methods and analytical techniques for determining distribution, amounts, and sources of mercury, DDT and PCB in the Stockholm archipelago and two island lakes are also given. (Auen-Wisconsin) W77-04571

ALLEGIC SELECTION IN A FISH (*Gymnocephalus cernua* (L.)) SUBJECTED TO HOTWATER EFFLUENTS

Institute of Freshwater Research, Drottningholm (Sweden).

L. Nyman.

Fishery Board of Sweden, Institute of Freshwater Research Report No. 54, p. 75-82, 1975. 1 fig., 3 tab., 21 ref.

Descriptors: \*Thermal pollution, \*Fish genetics, \*Fish migration, \*Adaptation, Foreign countries, Environmental effects, Ecotypes, Heated water, Water temperature, Nuclear powerplants.

Identifiers: Sweden, \*Gymnocephalus cernua.

Effects of thermal effluents on the migratory patterns and genetic transformations of fishes were investigated in the cooling water discharge of Oskarshamn Nuclear Power Station situated on Sweden's Baltic coast, using the local ruff (*Gymnocephalus cernua*) populations. The discharge increased ambient temperature about 10 centigrade. Tabulations are given for the distribution of esterase phenotypes within each of the eight ruff populations sampled, the estimated allelic frequencies and diallelic polymorphism in

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panmictic populations. Migratory patterns of ruff influenced by the heated effluents indicated that individuals attracted by the hot water in 1972 and 1973 had high frequencies of the 'fast' allele of the plasma esterase polymorphism, whereas fish leaving the heated area displayed significantly lower values. Results show how a species generally considered a coldwater form adapted genetically in one year to an induced environmental change by attracting individuals from other populations with a genetic configuration more relevant to the new conditions, consequently changing migratory patterns. Gene frequency was the controlling factor between fish attracted and those repelled by heated water. Biological implications of artificial temperature changes causing allelic selection are discussed. (Auen-Wisconsin)  
W77-04572

**OBSERVATIONS ON THE PROBLEMS OF POLLUTION IN SHATT AL-ARAB, IRAQ.**  
Alexandria Univ. (Egypt). Dept. of Oceanography. For primary bibliographic entry see Field 5B.  
W77-04575

**RESPONSE OF AEROBIC COMMUNITY METABOLISM TO CHEMICAL TREATMENT OF AQUATIC MACROPHYTES,**  
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.  
R. J. Strange, and C. B. Schreck. Aquatic Plant Management, Vol 14, p 45-50, 1976. 4 fig, 11 ref. DAW 65-74-C-0013.

Descriptors: \*Aerobic conditions, \*Aquatic weed control, \*Chemcontrol, \*Oxygen sag, Dissolved oxygen, Diquat, \*Virginia, Photosynthesis, Metabolism, Phytoplankton, Oxygenation. Identifiers: \*Chickahominy Reservoir(Va), Endothal.

Applications of a herbicide mixture of diquat and endothal to reduce the submerged macrophyte *Egeria densa* in Chickahominy Reservoir, Virginia, altered the aerobic community metabolism in areas of moderate and heavy infestation. Recovery of the phytoplankton community metabolism without a period of dissolved oxygen depletion averted fish kills and maintained macroinvertebrate community stability. Stations with moderate and heavy macrophyte growth consistently showed negative oxygen budgets immediately after treatment, but oxygen equilibria were reached six to seven weeks later and were still in effect the following year. Net community oxygen consumption was supported by atmospheric oxygen diffusion. The lightly-infested station showed no post-treatment change in daily oxygen budget patterns. The 24-hr oxygen budgets of the phytoplankton assemblage at the moderately-infested station showed a brief slump after treatment; within three weeks oxygen budgets increased to three times pretreatment levels. A phytoplankton bloom and a positive oxygen budget was evident in the treated bay a month after treatment, compared with less than half the phytoplankton and a negative oxygen budget in the untreated bay. Phytoplankton numbers increased in the untreated bay during the natural decline of *Egeria* but did not reach the bloom conditions of the previous summer, an indication that some of the phytoplankton increases in the treated areas may have been caused only by seasonal effects. (Auen-Wisconsin)  
W77-04576

**THE GROWTH AND DISTRIBUTION OF TWO SPECIES OF LAURENCIA, A RED MACROALGA, IN CARD SOUND, FLORIDA,**  
Miami Univ., Coral Gables, Fla.  
M. N. Josselyn. MS thesis, May 1975. 130 p. 17 fig, 6 tab, 108 ref, append.

Descriptors: \*Marine algae, \*Rhodophyta, \*Standing crops, Subtropic, \*Biomass, \*Florida, \*Growth rates, Benthic flora, Seasonal, Spatial distribution, Plant growth, Shallow water. Identifiers: Card Sound(Fla), Laurencia poitei, Laurencia obtusa, Seaweeds.

A year-long study of periodic changes in biomass and growth rates of *Laurencia poitei* and *L. obtusa* in shallow, subtropical Card Sound, Florida, indicated patchy areal distribution for both species along with marked differences in seasonal change. The biomass of *L. poitei* increased gradually from fall to late winter but declined sharply during summer; *L. obtusa* biomass was highest during the warmer months. Biomass of both species was dependent upon growth, oment and losses to other trophic levels. *L. poitei* growth varied seasonally as well as between plants and stations, with the variations due to physiological adaptation to its ecology or the natural senescence of plant thalli. Variation between stations was due primarily to the station's bathymetry, sediment composition, and circulation of the sound. Seasonal changes in growth rates of *Laurencia* was the result of the alga's response to optimal growth requirements; *L. poitei* grew best during early spring and late fall, at temperatures between 20 to 25°C and moderate sub-surface light levels; *L. obtusa* grew well during both winter and summer extremes. Fragmentation was greatest during periods of unfavorable growth conditions but decomposition of *L. poitei* was the same throughout the year and much faster than for other marine plants. (Auen-Wisconsin)  
W77-04578

**EFFECT OF THE NOVOROSSISK HEAT ELECTRIC POWER STATION WARM WATERS ON ZOOPLANKTON, (IN RUSSIAN),**  
Kuban State Univ., Novorossisk (USSR). Marine Biology Research Station.  
L. I. Goryainova. Gidrobiol Zh 11(6), p 28-33, 1975.

Descriptors: \*Zooplankton, \*Thermal pollution, Distribution, Electric powerplants, Water pollution effects, Heated water, Reservoirs, Water temperature. Identifiers: Novorossisk, Russian-Srfs, USSR.

Distribution of species composition and the quantitative development of zooplankton is shown for a zone of the Novorossiisk heat electric power station (Russian SFSR, USSR) heat flow where the average annual water temperature was 0.7-4.0 deg higher than that at the control station. Species composition and number of zooplankton in separate plots are analyzed as dependent on the distance from the place of arm water discharge. The data are presented on the effect of elevated temperatures on zooplankton development.—Copyright 1976, Biological Abstracts, Inc.  
W77-04583

**PREDICTION OF THE PHYTOPLANKTON DEVELOPMENT IN DESIGNED RESERVOIRS BY COMBINING A GROWTH-MODEL AND THE ANALOGY TO EXISTING RESERVOIRS, (IN GERMAN),**  
Technische Universitaet, Dresden (East Germany).

J. Benndorf, M. Zesch, and E. M. Wiesner. Int Rev Gesamten Hydrobiol 60(6), p 737-758, 1975.

Descriptors: \*Phytoplankton, Reservoirs, \*Forecasting, \*Growth rates, Model studies, \*Biomass, \*Mathematical models, Mixing, Water pollution effects.

By deriving the most significant physical characteristics (mixing depth, temperature of the mixed layer, length of the winter stagnation period) from existing reservoirs in connection with a simple mathematical model it was possible to predict the phytoplankton growth and biomass in designed

reservoirs. The method is applied to a designed reservoir. The reliability of the prediction method is tested by comparing the calculated results for the existing Säidenbach reservoir with the data measured in this water body by Hoehne (1970) and Hoffman (1972).—Copyright 1976, Biological Abstracts, Inc.  
W77-04584

**PRIMARY ORGANIC PRODUCTION IN A BRACKISH EUTROPHIC ENVIRONMENT (ETANG DE BERRE): EFFECTS OF STRONG DILUTION (FROM THE WATERS OF THE DURANCE), (IN FRENCH),**  
Centre d'Oceanographie, Marseille (France). Station Marine d'Endoume. M. Minas.

Mar Biol (Berl) 35(1), p 13-29, 1976.

Descriptors: \*Eutrophication, \*Primary productivity, Brackish water, Waste dilution, Water pollution, Lakes, Phytoplankton, Phosphates, Seasonal.

Identifiers: Durance, Etang-de-Berre, \*France, Organic, Phosphate.

14 C primary production measurements were made over a period of 5 yr (1965-1969, inclusive) in the brackish lake Etang de Berre near Marseilles (France). The diversion of the River Durance into the Etang de Berre took place during this period (March 1966) and introduced an important modification into the ecosystem, mainly through increased and variable freshening, accompanied by substantial nutrient input. The seasonal distribution of production rates displayed 3 bloom periods: the 1st (short and slight) in spring, the 2nd (the most important as regards intensity and duration) in summer, and the 3rd in autumn (Oct.). Before the diversion of the river in 1965, the C-uptake rates in the lake ranged between 25 mg/m<sup>2</sup> per day in winter and 800 mg/m<sup>2</sup> per day in summer-autumn, the mean value for the year being 150 g C/m<sup>2</sup> which represents 2.5 X 10<sup>4</sup> tons of photosynthesized C for the whole lake. After the diversion, more than 3000 mg C/m<sup>2</sup>, representing 6 x 10<sup>4</sup> tons of synthesized C for the whole lake. Noticeable variations occurred from one year to another. From the annual nutrient input of phosphate to the Etang de Berre through the inflow of Durance waters, the quantity of potentially synthesizable elements was calculated, in terms of C, according to the normal P:C ratio of organic substances; this quantity is called R. The difference between measured production P and R gives a measure of the regenerated production. This portion of production represented about 80% of the total production before 1968 but only 16% in 1969, a year of maximum freshwater inflow. This phenomenon could be due to modifications of the eophysiology of the phytoplankton resulting from the considerable freshening. With increasing nutrient load, eutrophication occurs first, then still greater dilution results in inhibition of production.—Copyright 1976, Biological Abstracts, Inc.  
W77-04587

**THE DISTRIBUTION OF CALLITRICE OB-TUSANGULA LEGALL IN THE STREAMS OF THE FRIEDBERGER AU REGION, (IN GERMAN),**  
Universitaet Hohenheim (Landwirtschaftliche Hochschule) (West Germany). Inst. of Plant Ecology.

A. Kohler. Ber Bayer Bot Ges Erforsch Heim Flora 46, p 131-132, 1975.

Descriptors: \*Eutrophication, \*Carbon dioxide, \*Distribution, Vegetation, Oligotrophy, Marshes, Drainage, Streams, Temperature.

Identifiers: \*Callitricha-obtusangula, Chara-hispida, Chara-vulgaris, Potamogeton-coloratus, \*West Germany(Friedberger au region).

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

*C. obtusangula* was not found during the vegetational mapping of this area (West Germany) in the autumn of 1972. Its ecological requirements and known biotopes are described. *C. obtusangula* requires eutrophic water rich in CO<sub>2</sub> and warm in the winter. Although this area is not quite suitable, the plant may spread upstream as eutrophication progresses in groundwater streams. The distribution of *C. obtusangula* should expand during the eutrophication of the oligotrophic marsh drainage ditches, while *Potamogeton coloratus*, *Chara hispida* and *C. vulgaris* regress.—Copyright 1976, Biological Abstracts, Inc.

W77-04588

**EFFECT OF KONAKOVA STATE REGIONAL ELECTRIC POWER STATION HEATED WATER DISCHARGE ON THE BREAM GROWTH IN THE IVANKOV RESERVOIR, (IN RUSSIAN),**  
Vserossiiskii Nauchno-Issledovatel'skii Institut Prudovogo Rybnogo Khozyaistva, Konakov (USSR). Upper Volga Div.  
G. B. Sappo.  
Gidrobiol Z 11(6), p 58-63, 1975.

Descriptors: \*Thermal pollution, \*Heated water, \*Growth rates, Electric powerplants, Nutrition, Reservoirs, Temperature, Water pollution effects. Identifiers: \*Bream growth, Ivankov, Konakov, Russian-Sfsr, USSR.

The differences in bream growth in the control section and in zones subjected to heating were marked. In the region of greatest heat the growth rate slows down. The most intensive growth is typical of fishes in the zone of weak heating. The observed changes in growth rate are in agreement with the fatness coefficients and nutrition intensity (Russian SFSR, USSR).—Copyright 1976, Biological Abstracts, Inc.

W77-04589

**EFFECTS OF SIMULATED PUMPED STORAGE OPERATION ON NORTHERN PIKE FRY, (IN GERMAN),**  
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).  
W. Geiger, H. J. Meng, and C. Ruhle.  
Schweiz Z Hydrol 37(2), p 225-232, 1975.

Descriptors: \*Pumped storage, \*Pikes, Mortality, \*Water level fluctuations, Fry, Reservoir operation. Identifiers: *Esox-lucius*.

The effects of periodic, simulated water level fluctuations on northern pike fry (*Esox lucius*) produced by pumped-storage operations were examined. Daily fluctuations of 10 cm caused a significant increase in the daily mortality rate. Waves reduced the detrimental effect of water level fluctuations, at least during the adhesive phase of fry.—Copyright 1976, Biological Abstracts, Inc.

W77-04590

**WATER OZONATION IN FISH CULTURE, (IN GERMAN),**  
Kanton Fischerei und Jagdverwaltung, Zurich (Switzerland).  
For primary bibliographic entry see Field 5F.

W77-04591

**STUDIES ON THE JAPANESE CHIRONIMID MIDGE AS A NUISANCE: I. LARVICIDAL EFFECTS OF SOME ORGANOPHOSPHORUS INSECTICIDES AGAINST THE LAST LARVAE OF CHIRONOMUS YOSHIMATSU MARTIN AND SUBLLETTE, (IN JAPANESE),**  
National Inst. of Health, Tokyo (Japan). Dept. of Medical Entomology.  
Y. Inoue, and M. Miura.  
Jpn J Sanit Zool 26(2/3), p 135-138, 1975.

Descriptors: \*Diptera, \*Midges, Larvacides, Larvae, \*Insecticides, \*Organophosphorus pesticides, Aquatic insects, Rivers. Identifiers: *Chironomus-yoshimatsu*, Fenitrothion, Fenthion, Malathion, Temefos, Japan, Nuisance insects.

Using small model water-courses formed with a tin gutter (depth: 0.07 m, width: 0.1 m, length 1.8 m, water velocity: 15 m/min) suspended in a stream, larvicidal effects of some organophosphorus insecticides were evaluated against the last instar larvae of *Chironomus yoshimatsu* which are a serious nuisance at some urban river sides in Tokyo, Gifu and Ogaki. The larvae used in the test were collected from the Kanda river in 1972 and were reared in successive generations in the laboratory. Emulsifiable concentrates of temefos 5%, fenitrothion 10%, fenthion 5% and malathion 20% were used. In a glass tube contact method, performed by exposing larvae enclosed in a bottomless glass tube to the stream treated with a certain concentration of the insecticides, temefos was most effective and the others were insufficient when the insecticides were introduced into the stream at the concentration of 1-2 ppm active ingredient to the volume of the stream flow for a period of 10 min. Because chironomid larvae usually inhabit nests on the bottom mud, another contact test with the nested larvae was performed by introducing the condition of their natural habitat into the water-course. The effectiveness is strongly fluctuated due to the above mentioned circumstances, whether or not the nest case is evident. A range of insecticide concentrations must be decided in relation to a length of time for treatment.—Copyright 1976, Biological Abstracts, Inc.

W77-04592

**NEGATIVE EFFECTS OF PHOSPHATE IN SURFACE WATERS, (IN GERMAN),**  
E. A. Thomas.  
Schweiz Z Hydrol 37(2), p 273-288, 1975.

Descriptors: \*Phosphates, Surface waters, \*Algae, Water pollution effects, Chlorophyta, Nuisance algae, Submerged plants, Water treatment, Water pollution control.

Phosphates cause increased proliferation of submerged flowering plants or green filamentous and other algae types in surface waters. These tangles of growth impede the water flow, distort the flow rates calculated on the basis of the water level and disrupt bathers, shipping activities, fishing and fish breeding, power plant operations, the replenishment of the underground aquifer and the preparation of water for drinking. Primary and secondary wastewater treatment cannot offset the strong imbalance produced in surface waters. Protective measures are discussed.—Copyright 1976, Biological Abstracts, Inc.

W77-04593

**BIOCHEMICAL COMPOSITION AND ENVIRONMENTAL CONDITIONS OF VENERUPIS DECUSSATA AND VENERUPIS PULLASTRA IN THE PASAJE ESTUARY, LA CORUNA, (IN SPANISH),**  
Instituto Espanol de Oceanografia, Madrid (Spain).  
N. Gonzalez.  
Bol Inst Esp Oceanogr 194, p 1-44, 1975.

Descriptors: \*Biochemistry, \*Shellfish, \*Organic matter, \*Nutrients, Ecological distribution, Commercial fishing, Environmental effects, Water pollution, Estuaries, Cycling nutrients. Identifiers: La-coruna, \*Venerupis-decussata, \*Venerupis-pullastra, Spain (Pasaie estuary).

The production of commercially-valuable shellfish is due to the high concentration of organic particulate matter and the existence of 3 sources of inorganic nutrients: freshwater; upwelling; and regeneration from the muddy bottom (Spain). The

elemental composition of 2 spp. of economic importance: *V. decussata* and *V. pullastra* were studied in relation to ecological parameters. Commercial exploitation more in accord with the annual condition cycle is recommended.—Copyright 1976, Biological Abstracts, Inc.

W77-04594

**TASKS AND PRINCIPLES OF BIOLOGICAL ANALYSIS OF THE DEGREE OF POLLUTION OF WATER BODIES, (IN RUSSIAN),**  
Astrakhan State Reservation (USSR).  
For primary bibliographic entry see Field 5A.  
W77-04598

**DATA ON SUBSTANTIATION OF THE MAXIMUM ALLOWABLE CONCENTRATION OF YALAN IN WATER BODIES, (IN RUSSIAN),**  
Vsesoyuznyi Nauchno-Issledovatel'skii Institut Gigiene i Toksikologii Pestisidov, Kiev (USSR). K. K. Vrochinskii, S. E. Panchenko, and N. A. Popovich.  
Gig Sanit 10, p 104-105, 1975.

Descriptors: \*Herbicides, \*Carbamate pesticides, \*Toxicity, Water bodies, Lakes, Rice, Pollutant identification, \*Lethal limit.

Identifiers: Cleansing, Differentiation, Lakes, Mains, Mycobacteria, Mycobacterium-aquae, Mycobacterium-fortuitum, Mycobacterium-gordoniae, Mycobacterium-phlei, Mycobacterium-tuberculosis, Pools, Stations, Swimming, Thermal, Water, \*Yalan, Carbamates.

Toxicological investigations on rats and mice of the herbicide yalan (Ordram, S-ethyl-N-hexamethyleneiminothiocarbamate), used for treating areas where rice is to be sown, showed that a considerable role in the mechanism of action of this herbicide is played by disturbances of oxidative processes in the body, development of hypothermia and shifts in the hypophyseal-adrenal cortical system. Changes were noted in the indices of the peripheral blood, evidenced by a decrease of the Hb content, decrease of the hematocrit number, erythropenia and moderate leukocytosis. In rats a dose of 13 mg/kg was toxic in a chronic experiment. The recommended maximum allowable concentration is 0.02 mg/l. The limiting index is its effect on the organoleptic properties of water.—Copyright 1976, Biological Abstracts, Inc.

W77-04599

### 5D. Waste Treatment Processes

**POTENTIAL REPLACEMENT OF SEPTIC TANK DRAIN FIELD BY ARTIFICIAL MARSH WASTE WATER TREATMENT SYSTEMS, (IN SPANISH),**  
Wisconsin Univ.-Oshkosh. Dept. of Geology. C. W. Fetter, W. E. Sloey, and F. L. Spangler. Groundwater, Vol. 14, No. 6, p 396-401, November-December, 1976. 3 fig, 3 tab, 16 ref.

Descriptors: \*Liquid wastes, \*Sewage, \*Sewage disposal, \*Sewage ponds, Sewage treatment, Waste water (Pollution), Wastewater disposal. Vegetation effects, Chemical oxygen demand, Biological oxygen demand, Nitrate, Phosphorous. Identifiers: \*Artificial marsh wastewater treatment system.

Individual, subsurface, liquid waste disposal has been cited as a source of ground-water contamination. Waste water treatment systems using emergent marsh vegetation planted in a gravel substrate in a plastic lined trevel could be used to treat septic tank effluent. A pilot plant treating unchlorinated primary municipal effluent achieved the following reductions in mass: BOD-77%; COD-71%; Orthophosphate-35%; total phosphorus-37%; Nitrate-22%, coliform bacteria 99.9%. While such treatment is possible only during the growing season, it could be useful at summer cottages, camping areas, resorts and roadside rest areas.

Marsh treatment systems are inexpensive to operate and virtually automatic. (Heiss-NWWA) W77-04117

**SUCROSE REMOVAL FROM CANE SUGAR MILL WASTE STREAMS BY ION EXCHANGE**, Louisiana Water Resources Research Inst., Baton Rouge.

F. R. Groves, Jr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 465, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, October 1976. 21 p, 14 fig, 3 tab, 7 ref, 3 append. OWRT A-036-LA(1), 14-34-0001-6019.

Descriptors: \*Ion exchange, \*Waste water treatment, Sugarcane, Industrial wastes, \*Hydrolysis, Operating costs, Catalysts, Enzymes.

Identifiers: \*Sugar mill waste water, Glucose, Fructose, Sucrose, Boric acid.

Small amounts of sucrose in sugar mill waste water were removed by hydrolyzing sucrose to glucose and fructose and then removing these sugars by complexing with boric acid held on an ion exchange resin. Hydrolysis of sucrose utilized the enzyme invertase as a catalyst. Attempts were made to immobilize invertase on various solid supports. Best activity and stability were obtained with iodine substituted invertase on Duolite phenolic resin treated with gluteraldehyde. The immobilized enzyme was uneconomical, so the preliminary design was based on direct addition of invertase to the waste water. Removal of glucose/fructose from solution was studied using Amberlite IRA 400 (strongly basic anion exchange resin) in the borate form. Three hundred bed volumes of a solution containing 100 mg glucose plus 100 mg fructose per liter could be treated at a rate of 50 bed volumes per hour before breakthrough of sugar into the effluent. Boric acid in the effluent could be reduced to less than 10 ppm by passing through a second column of resin in the hydroxyl form. A preliminary design and economic study was made based on treating 5 MGД of condenser cooling water containing 200 ppm sucrose. The process produces 5 MGД of pure water (<10 ppm sugar; <10 ppm boric acid) for reuse. It also produced 167,000 GPD of a concentrated waste containing 6000 ppm sugar plus boric acid and HC1. Capital investment was estimated at \$1,500,000. Predicted operating costs were \$1.45 per 1000 gallons of water treated. The process appears uneconomical in its present form as compared to conventional biological treatment methods.

W77-04142

**ASSESSING TREATMENT PROCESS EFFICIENCY WITH THE ALGAL ASSAY TEST**, Robert S. Kerr Environmental Research Lab., Ada, Okla.

R. E. Thomas, and R. L. Smith.

In: Proceedings: Biostimulation and Nutrient Assessment Workshop, October 16-17, 1973, National Environmental Research Center, Corvallis, Ore., Report No. EPA-660/3-75-034, June 1975. p. 244-248. 1 tab.

Descriptors: \*Sewage treatment, \*Bioassay, Soil filters, Laboratory tests, Sewage lagoons, Feed lots, Municipal wastes, Waste water (Pollution), Analysis, \*Waste water treatment, \*Pollutant identification.

Identifiers: \*Algal assay, \*Sewage treatment efficiency, Algal assay procedure bottle test, Spray-runoff waste treatment.

The efficiency of spray-runoff (overland flow) treatment of cattle feed lot and municipal wastes was determined through application of the standard bottle test procedure, using *Selenastrum capricornutum* as the inoculum, and measuring the development of the maximum standing crop with fluorescence determinations and gravimetry. The

algal assays were conducted with samples taken from a storage lagoon from which the wastewater was pumped to the spray-runoff area, and from the spillway of a small farm pond which was the final step in the multi-unit treatment system. Municipal wastewater samples were taken from the discharge line of the standard trickling filter plant and from the overflow of a flow-measuring flume at the spray-runoff test area. The tests indicated that algal assays are promising tools for evaluating the eutrophication potential of different wastewater treatment processes. Even though nitrogen and phosphorus concentrations of the product waters were substantially greater than those in waters for which the algal assay was developed, biomass production was directly related to the concentration of nitrogen and/or phosphorus in the product water. The relationships observed in the test appear suitable for direct comparisons at specific locations. However, attempts to extrapolate results between wastewaters and to differing wastewater sources could lead to erroneous interpretations. (See also W77-04153) (Auer-Wisconsin) W77-04164

**ALTERNATIVE METHODS OF FINANCING WASTEWATER TREATMENT**, Environmental Protection Agency, Washington, D.C. Office of Planning and Evaluation. For primary bibliographic entry see Field 5G. W77-04167

**A COMPARISON OF INACTIVATION OF BACTERIOPHAGE AND ENTEROVIRUS DURING ACTIVATED SLUDGE TREATMENT**, New Mexico State Univ., University Park. Dept. of Biology.

J. S. Glass, and R. T. O'Brien.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 496, Price codes: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Report No. 079, September 1976, 52 p, 6 fig, 14 tab, 30 ref, 1 append. OWRT A-052-N Mex(3). 14-34-0001-7066.

Descriptors: \*Bacteriophage, \*Viruses, \*Domestic wastes, \*Human diseases, Sludge treatment, \*Activated sludge, Aerobic treatment, \*Waste water treatment, Microorganisms, Water pollution sources, Environmental sanitation, Human pathology, Public health, Water pollution, Bioindicators.

Identifiers: \*Poliovirus, \*Coxsackievirus, Inactivation rate, Dialysis membrane, \*Enterovirus.

Inactivation of indigenous bacteriophages was followed during extended-aeration activated sludge treatment of domestic sewage. Also, a bacteriophage was isolated from the sewage and used to follow the inactivation of phages contained inside a dialysis membrane chamber immersed in an activated sludge aeration reactor. Finally, inactivation of Poliovirus T-1 and Coxsackievirus B-1 contained inside immersed membrane chambers was followed. Statistical comparisons showed no detectable difference between phage inactivation rate constants measured in the aeration reactors and in immersed membrane chambers. No significant differences were detected between inactivation rate constants for Poliovirus T-1 and Coxsackievirus B-1. Finally, no significant differences were detected between inactivation rate constants for phage and enteroviruses inside immersed membrane chambers. The results suggest that immersed dialysis membrane chambers may provide an accurate, reliable method for measuring virus inactivation during activated sludge treatment, and that bacteriophages may provide a convenient indicator system for virus inactivation during this process. (Hain-New Mexico State) W77-04180

**TREATMENT OF WOOD PRESERVING WASTEWATER**, Texas A and M Univ., College Station. Water Resources Inst.

T. D. Reynolds, and P. A. Shack.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 491, Price codes: A09 in paper copy, A01 in microfiche. Technical Report TR-79, October 1976. 164 p 25 tab, 38 fig, 54 ref, 3 append. OWRT A-031-TEX(1). 14-31-0001-5044. 14-34-0001-6045.

Descriptors: \*Wood wastes, \*Waste water treatment, Carbon, Chemical oxygen demand, Industrial wastes, \*Evaporation.

Identifiers: \*Atmospheric evaporation ponds, \*Wood preserving wastes, Organic carbon.

The wastewater produced by the wood preserving industry is difficult to treat economically. A review of the literature indicates the size of the industry has limited the pursuit of an orderly and economic solution. Atmospheric evaporation was one possible means of treatment which had not been studied to any great degree. Two bench scale evaporation units were employed to determine the fundamental relationships affecting wastewater quality during such treatment. In batch evaporation tests, it was repeatedly demonstrated that a constant rate of total organic carbon and chemical oxygen demand removal occurred as the wastewater was evaporated. A procedure for designing atmospheric evaporation ponds was developed and applied to a hypothetical wood preserving plant. From this example design estimates of equivalent hydrocarbon concentrations in the air downwind of the pond are made. Various other design considerations such as the input data, modifications to the design procedure, and solids accumulation are discussed. A treatment scheme incorporating atmospheric evaporation ponds after chemical coagulation and settling is proposed.

W77-04181

**AN ANALYSIS OF U.S. ENVIRONMENTAL PROTECTION AGENCY'S NEEDS SURVEY**, American Public Works Association, Chicago, Ill. For primary bibliographic entry see Field 5G. W77-04308

**ENTERIC VIRUS REMOVAL FROM SEPTIC TANK EFFLUENT BY PILOT SCALE SOIL ABSORPTION SYSTEMS**, North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.

M. D. Sobsey, R. R. Jacobs, B. L. Carlile, and L. Stewart.

Paper presented at the 3rd National Conference on Environmental Engineering Research, Development and Design, July 12-14, 1976, Seattle, Washington, 2 p. OWRT A-090-NC(2), 14-34-0001-7070.

Descriptors: \*Viruses, \*Septic tanks, Effluents, \*Enteric bacteria, Land treatment, \*Waste water treatment, Absorption, Soil disposal fields.

Identifiers: Land disposal, \*Virus removal, Soil columns.

The fate of enteric viruses in soils is an important public health consideration in the land disposal of wastewater. Home sewage disposal units are of particular concern with respect to enteric virus contamination because of their widespread use and the frequency with which inadequacies in planning, design, construction and operation occur. In order to quantitatively evaluate the potential effectiveness of home sewage disposal systems for enteric virus removal, studies were made of the extent of virus removal from septic tank effluent (STE) applied to pilot scale soil absorption systems. Each soil absorption system consisted of a soil column which as 5 feet long and 6 inches in diameter and had an unsaturated upper zone of 3 feet and a saturated bottom zone of 2

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

feet. The soil composition of the upper zone was either fine, loamy sand or a 1:1 mixture of fine, loamy sand and medium sand. The saturated bottom zone was composed of either gravel or a 1:2 mixture of organic soil (27 percent organic matter) and medium sand. There were a total of four different columns; one for each possible combination of upper and lower zones. The results of these column studies with both poliovirus and reovirus indicate that adequately designed and properly operated soil absorption systems can potentially achieve extensive virus removals from STE. Studies are now in progress to attempt to recover polioviruses and reoviruses from the contents of the soil columns. (Stewart-NC State) W77-04389

**AROMATIC NITRO-OXYGEN COMPOUNDS REMOVAL FROM WASTE WATER-BY-TREATMENT OF STRONGLY BASIFIED AND FILTED WASTE WITH ACTIVATED CARBON, V. I. Repkina.**  
Soviet Patent SU-482-394. Issued March 20, 1976. Soviet Inventions Illustrated, Vol. X, No. 43, p D4, December, 1976.

Descriptors: \*Patents, \*Waste water treatment, \*Activated carbon, \*Nitrogen compounds, Waste water(Pollution), Waste treatment, Filters, Aromatic compounds, \*Chemical wastes. Identifiers: \*Oxygen compounds.

A patent was issued for a method of removing aromatic nitro-oxygen compounds from waste water by activated carbon. Waste resulting from the production of dinitrosoomonemethylaniline is altered to pH of 11-12 before treatment. Longer treatment by activated carbon is necessary if a lower pH (8-10) is used. The weak base milk of lime is preferred as a neutralizing agent. A colloidal precipitate is produced which is filtered off. This filtrate is passed through an AG-N grade activated carbon that acts as a reducing and absorbing agent. (Collins-FIRL) W77-04445

**ONE CHEMICAL COMPANY'S APPROACH TO THE PROBLEM,**  
Hickson and Welch, Ltd., Castleford, (England). For primary bibliographic entry see Field 5A. W77-04446

**WASH WATER RECYCLING BY CATALYTIC OXIDATION OF THIOSULFATES AND SULFITES,**  
Mead Technology Labs., Dayton, Ohio.  
D. A. Fatora.  
Journal of Applied Photographic Engineering, Vol. 2, No. 4, p 227-228, 1976. 2 fig, 5 ref.

Descriptors: \*Trickling filters, \*Treatment facilities, \*Recycling, \*Catalysts, \*Oxidation, Freshwater, \*Waste water treatment, Effluents. Identifiers: Photographic processes, Thiosulfate, Sulfite.

A wash water recycling system which reduces fresh water needs and contaminated effluent is described for application with photographic processes. The system consisted of a column filled with a catalyst. Air and water contaminated with thiosulfate and sulfite is pumped into the top and distributed over the inside column area. Then the air/liquid phases trickle down through the catalyst bed and oxidation is concurrent. Results proved the effectiveness of the trickle-bed reactor in oxidizing thiosulfate and sulfite solutions to sulfate. It is effective in recycling wash water and reduces fresh water requirements. (Collins-FIRL) W77-04447

**SWECO CSC SYSTEM INSTALLED AT TURKEY PROCESSING PLANT.**  
Water and Pollution Control, Vol. 114, No. 10, p 15-16, October, 1976. 1 fig.

Descriptors: \*Waste water treatment, \*Treatment facilities, \*Industrial plants, \*Food processing industry, \*Industrial wastes, \*Centrifugation, Suspended solids, Effluents. Identifiers: Grease, Centrifugal screen concentrator.

A **centrifugal Screen Concentrator (CSC) system** was installed to reduce the high levels of grease and suspended solids in the waste effluent of a turkey processing plant. The system consists of two centrifugal screen concentrators, a high-rate air entrainment flotation cell and a Vibro-Energy Separator. The combination of screen rotation and impingement velocity of the influent allows removal of particles smaller than the wire openings. In the flotation cell, soluble oils and grease that passed through the screens are lifted by air bubbles and combine with suspended solids in the foam and build into particles larger than the screen openings. The concentrated materials are skimmed off and pumped to disposal trucks. Final dewatering occurs in the separator. Solids from this step are pumped with that of the flotation cell to disposal trucks and the filtrate is recycled through the total CSC system. The screening is automatically backwashed as necessary. An effluent of 200 ppm suspended solids, 50 ppm grease and 360 ppm BOD results. Higher BOD (over 300 ppm) was traced to isolated blood spills. (Collins-FIRL) W77-04448

**COMBINED TREATMENT OF INDUSTRIAL AND MUNICIPAL WASTE WATERS BY ACTIVATED SLUDGE. PILOT PLANT SCALE EXPERIMENTS (OCZYSZCZANIE ODCIEKOW Z PRODUKCJI DROZDZY PASZOWYCH NA WYWARZE MELASOWYM WSPOLNIE ZE SCIEKAMI MIEJSKIMI BADANIA W SKALI CIWIERCZTECHNICZNEJ,**  
J. Tomczynska, J. Klimiuk, and E. Klimiuk.

Descriptors: Waste water(Pollution), \*Pilot plants, \*Waste dilution, \*Waste water treatment, Industrial wastes, Municipal wastes, Biochemical oxygen demand, \*Activated sludge. Identifiers: \*Industrial waste water, \*Municipal waste water.

The use of activated sludge to treat raw post-yeast spent wash mixed with municipal waste waters was investigated. The raw post-yeast spent wash was diluted with waste waters from fodder yeast production, molasses distillery slops, and municipal waste water to obtain the proper concentration for activated sludge treatment. BOD<sub>5</sub> of the mixtiture of fodder yeast production and municipal waste waters, averaged 690 mg of 02 per cubic decimeter. With a loading up to 1.0 kg BOD<sub>5</sub>/kg MLVSS obtained by activated sludge, BOD<sub>5</sub> removal was 92-93% and BOD<sub>5</sub> of the effluent was 50 mg of 02 per cubic decimeter. Excessive sludge formed during the process, containing a high percentage (52%) of protein was successfully used as fodder. (Collins-FIRL) W77-04449

**HIGH YIELD STRIPPING COLUMN FOR ALCOHOLIC SOLUTIONS--WITH RECOVERY OF BY-PRODUCTS TO AVOID POLLUTION,**  
C. Coutor.

French Patent FR 2296-690. Issued September 3, 1976. Derwent French Patents Abstracts, Vol X, No 45, p D11, December, 1976.

Descriptors: \*Patents, \*Treatment facilities, \*Columns, \*Aqueous solutions, \*Byproducts, Alcohols, Distillation, \*Waste water treatment. Identifiers: Stripping column.

A patent was issued for a high yield stripping column for alcoholic solutions. The column has an upper inlet through which the solution enters and descends to an overflow and passes through a pipe to a heat exchanger. There is an outlet for residual liquor. Steam enters the column from the boiler.

Alcohol passes out in a gaseous state and alcohol-free residue is collected at the base of the column. The residue is fed to the boiler and a part goes through pipes for recycling. Valuable residues are recovered by pipe from the boiler base. The alcohol-rich gaseous products are concentrated in the column to produce highly concentrated alcohol which is removed by a pipe. This method produces marketable materials and prevents pollution. (Collins-FIRL) W77-04450

**COPPER REMOVAL FROM WASTE WATER-BY PRECIPITATION WITH AN ALKALINE SALT OF AN ORGANIC ACID,**  
A. L. Momot.

Soviet Patent SU 484-189. Issued March 19, 1976. Soviet Inventions Illustrated, Vol X, No 43, p D5, December, 1976.

Descriptors: \*Patents, Waste water(Pollution), \*Chemical precipitation, \*Salts, \*Organic acids, Sodium compounds, \*Waste water treatment, Copper.

Identifiers: \*Copper removal.

A patent was issued for a process to remove copper from waste water by precipitation with an alkaline salt of an organic acid. Copper is removed from the wastes of galvanic etching of copper and bronze by precipitation with alkali in the presence of sodium monochloracetate. The reagent is added and a precipitate is quickly formed and readily processed. The procedure takes about 5 minutes and is almost 100% effective. Precipitation by alkali alone leaves 0.1 to 1.0 mg/liter of copper in the waste. (Collins-FIRL) W77-04451

**SELECTIVE SEPARATION OF NICKEL(II) BY DIMETHYGLYOXIME-TREATED POLYURETHANE FOAM,**  
Yonsei Univ., Seoul (Republic of Korea). Dept. of Chemistry.

D. W. Lee, and M. Halmann.

Analytical Chemistry, Vol 48, No 14, p 2214-2218, December, 1976. 11 tab, 19 ref.

Descriptors: \*Adsorption, \*Aqueous solutions, \*Hydrogen ion concentration, \*Temperature, \*Waste water treatment, Separation techniques, Foam separation, \*Nickel.

Identifiers: Dimethylglyoxime-treated polyurethane foam.

Dimethylglyoxime (DMG)-treated flexible open-pore polyurethane foam was used in quantitative and selective adsorption of nickel from aqueous solutions. Investigations were concerned with optimal conditions such as pH range, temperature, contact time, nickel concentration limits, and effects of foreign ions. Tests indicated that adsorption is probably the result of physical wetting on the foam matrix and some kind of chemical bonding, perhaps molecular sorption between DMG molecules and the foam matrix. The pH range of 8-10 produced the best results. Temperature was found to have no effect on performance. The mole ratio of Ni(II):DMG in the foam is approximately 1:2.6. The theoretical ratio for the Ni(DMG)<sub>2</sub> complex is 1:2, indicating that some of the dimethylglyoxime on the foam was not available to the reaction with nickel. Of the ions tested, only Co(II) interfered with the reaction. The batch method was effective in adsorbing nickel down to 0.5 ppm concentrations. Elution methods were effective at concentrations less than 0.5 ppm, but results were less than with the batch method. (Collins-FIRL) W77-04452

**CLOSED LOOP WATER RECYCLING SYSTEM SOLVES WASTE PROBLEM,**  
Mogul Corp., Chagrin Falls, Ohio.  
J. P. Bell.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

Industrial Wastes, Vol 22, No 6, p 20-22, November/December, 1976. 2 fig, 3 tab.

Descriptors: \*Treatment facilities, \*Recycling, \*Waste water disposal, \*Cleaning, \*Neutralization, \*Waste water treatment, Sludge disposal, Water reuse, \*Industrial wastes.

Identifiers: Metal cleaning processes.

A closed-loop water recycling system was used by the Eaton Corporation to solve waste water discharge problems from metal cleaning processes. This water contains materials carried from sulfuric acid pickling tanks and from caustic permanganate tanks as well as ferrous sulfate. Neutralization by lime or lime slurry and 50% sodium hydroxide produced a substantial sludge. On-site neutralization was not judged economically viable. The use of a gang stirring machine with a coagulant combination of alum and an anionic polyelectrolyte proved successful. The process consisted of a first stage in which waste water discharge is mixed in an equalization sump which eliminates side pH fluctuations and minimizes the need of chemical additions. The second stage finds the waste pumped into the neutralization system. Then waste is discharged into a transfer tank and then to a clarifier. Clarifier overflow is transferred to a clear well and the clear water is pumped through a polishing filter to remove all traces of suspended solids and then back to the wire coil rinsing tanks. The system must be periodically bled of water and fresh water added to minimize contamination. Sludge discharge was disposed by municipal treatment plants. (Collins-FIRL)

W77-04453

#### CONCENTRATION OF OILY AND LATEX WASTE WATERS USING ULTRAFILTRATION INORGANIC MEMBRANES,

I. K. Bansal.

Industrial Water Engineering, Vol 13, No 5, p 6-11, October/November, 1976. 11 fig, 4 tab, 5 ref.

Descriptors: \*Oily water, Waste water(Pollution), \*Membranes, \*Inorganic compounds, \*Industrial wastes, \*Waste water treatment, Oil pollution, Filtration, Membrane processes.

Identifiers: \*Latex waste water, Industrial waste water, \*Ultrafiltration.

Ultrafiltration was tested as a means of removing oily and latex materials from industrial waste waters. The ultrafiltration (UF) system used has an ultrafiltration membrane consisting of thin inorganic layers on the inside of strong, inert, temperature- and abrasion-resistant carbon tubes. The membrane can be used with a wide range of acidity or alkalinity (pH 1 to 14). Optimum operation is within the range of 20 to 100 pounds per square inch of pressure and a 2.0 to 3.0 gallons per minute circulation flow rate per tube. Results of laboratory experiments showed that the system could effectively concentrate waste oil emulsions to 25% or higher concentrations and produce a permeate acceptable for reuse of discharge. A 70% concentration can be achieved by a pH adjustment. Dilute latex waste water is economically concentrated with the system. The permeate is like distilled water and has 8 ppm of suspended solids. At present hauling rates, ultrafiltration is economically viable. (Collins-FIRL)

W77-04454

OIL CONSERVATION AND RECLAMATION, APV Bowser Filtration, Ltd., Croydon (England). D. J. Major.

Chemical Engineer, No. 315, p 757-759, 764, November/December, 1976. 5 fig, 1 tab.

Descriptors: \*Oil wastes, Conservation, \*Reclamation, \*Costs, \*Ecology, Waste water treatment, Sludge treatment, Economics, Industrial wastes.

Identifiers: \*Coalescer method, Oil conservation, Oil reclamation, United Kingdom.

The circumstances and processes involved in oil conservation and reclamation have become more important due to the growing scarcity and costs of oil. Concern is orientated towards nations in the circumstances of the United Kingdom. Ecological and economic considerations make these solutions attractive. Processing used oil for re-use or for heat recovery is already wide-spread. These nations must face the problem of collecting and disposing of large quantities of oily water waste, oily sludges, waste emulsion and crankcase oil. The coalescer method, with the centrifuge, can handle large amounts of water and can remove free water from lighter-than-water oils. The vacuum process handles heavier-than-water oils and removes soluble water and degassifies. Government influence and control as well as the use of advanced technology are recommended as useful incentives and means for further reducing oil waste. (Collins-FIRL)

W77-04455

#### OXYGEN/ALKALI DELIGNIFICATION AT KAMYR DIGESTER BLOWLINE CONSISTENCY — A STATUS REPORT,

Peterson and Son, Moss (Norway).

P. J. Kleppe, A. Backlund, and Y. Schildt.

Tappi, Vol. 59, No. 11, p 77-80, November, 1976. 6 fig, 2 tab, 5 ref.

Descriptors: \*Treatment facilities, \*Oxygen, \*Digestion, Pulp and paper industry, \*Mills, Industrial production, Suspension, Pressure, Temperature, \*Pulp wastes, Industrial wastes.

Identifiers: \*Delignification.

Experiences are described for a mill-scale experimental oxygen/alkali reactor system, where kraft/poly sulfide pulps from a Kamyr digester high-heat washing zone are delignified from a kappa number of 50-60 down to approximately 23-30. A defibrator is used to mix finely dispersed oxygen into the pulp suspension at approximately 8% consistency. Pressurized air keeps the pressure in the reactor at the desired level and the turpentine content is kept well below the explosion limit by controlled degassing of the reaction, which results in almost no oxygen loss. The reactor has been successfully proven. The reduction in kappa number is mainly dependent upon the alkali charge, as long as a sufficient amount of dispersed oxygen is present and reaction temperature is between 100 and 115 C. The delignification reactor can be controlled by measuring pulp flow and temperature, alkali and oxygen charges, pH of the outgoing pulp, oxygen and turpentine content of the exhaust gas, the pressure in the reactor. The viscosity of the oxygen-delignified pulp is 960 to 1150 cu cm/g, a satisfactory level. The formation of carbon monoxide is 0 to 50 g/tow of pulp. Pulp flow through the reactor was equivalent to approximately 75 and 100 metric ton/day; trial periods lasted from a few hours up to 5 days. Potential applications are described. (Snyder-FIRL)

W77-04456

#### BASIN AGENCIES AND THE FIGHT AGAINST INDUSTRIAL POLLUTION (LES AGENCIES DE BASSIN ET LA LUTTE CONTRE LA POLLUTION INDUSTRIELLE),

J. C. Suzanne, D. Gros, and C. Peker.

Annales des Mines, Vol. 182, No. 11, p 27-32, November, 1976.

Descriptors: \*Waste water treatment, \*Biological treatment, \*Industrial wastes, Pulp and paper industry, \*Textiles, Control, Recycling, Financing, \*Pulp wastes.

Identifiers: \*Textile industry.

To fight industrial pollution, the Financial Agency of the Rhine-Meuse basin is helping industries find methods of control and recycling and is providing financial assistance. The Agency has already invested a total of \$3,400,000 in the paper industry. Water consumption has decreased by 40%, from

102 cu m/ton of manufactured paper in 1972-1973 to 63 cu m/ton of paper in 1975. Suspended solids have been reduced by 50%, from 27 kg to 13.8 kg. Organic pollution has decreased by 30%, from 8.1 kg to 5.7 kg. This decrease is due more to the recycling of white and clarified waters and to suspended solids control (flocculation-decantation, flocculation-flootation) than to the development of pollution control methods. More pollution control processes are needed. Recycled cardboard and wrapping paper plants must develop closed or almost closed circuits. Plants, which produce various types of papers using recycled paper or mechanical pulp, or which add organics such as latex and starch to the paper, are the greatest source of pollution and cannot incorporate closed circuits because of the nature of their products and present technology. Biological purification appears to be the most feasible option at present. (Waltner-FIRL)

W77-04457

#### REMOVAL OF SULFATE FROM INDUSTRIAL WASTE WATERS,

Commonwealth Scientific and Industrial Research Organization, Belmont (Australia). Div. of Textile Industry.

J. R. Christoe.

Journal Water Pollution Control Federation, Vol. 48, No. 12, p 2804-2808, December, 1976. 7 fig, 6 tab, 6 ref.

Descriptors: \*Industrial wastes, Waste water(Pollution), Investigations, \*Effluents, \*Industrial plants, \*Textiles, \*Waste water treatment, Sulfates, \*Treatment facilities.

Identifiers: Wool textile industry.

Investigations of the removal of sulfate from effluents of wool textile plants were reported. The main sources of sulfate-containing effluents in this industry are dyeing and carbonizing. Sulfate analysis was conducted on laboratory simulated carbonizing effluents. Results indicated that sulfate levels in waste waters were reduced by adding aluminum ions and lime at pH 10. The insoluble complex thus formed contained aluminum, sulfate and calcium molecules in a 2:3:6 ratio. If wastes contain coagulable material, the complex will not form until coagulation is practically complete. Allowance must be made for aluminum used in the coagulation when calculating dosages for these wastes. Sulfate content is easily reduced to discharge specifications, after normal alum treatment of sulfate-free wastes, by lime addition at a pH greater than 9.5. Coagulation of waste waters by aluminum chloride or a similar chemical can neutralize interfering suspended, colloidal, and emulsified matter when analyzing sulfate in wool carbonizing liquors. (Collins-FIRL)

W77-04458

#### REMOVAL OF VISCOSE FROM WASTE WATER-BY TREATMENT WITH MIXED MICROORGANISMS IN A HIGHLY ALKALINE MEDIUM,

I. A. Erevich.

Soviet Patent SU 468-897. Issued April 19, 1976. Soviet Inventions Illustrated, Vol. X, No. 43, p D2, December, 1976.

Descriptors: \*Patents, \*Biological treatment, Waste water(Pollution), \*Microorganisms, \*Alkalinity, Hydrogen ion concentration, \*Waste water treatment, Activated sludge, Industrial wastes.

Identifiers: \*Viscose.

A patent was issued for a process to remove viscose from waste water. The waste water is altered to a pH of 9-11.5 and treated with activated sludge. In addition to the usual organisms, the sludge contains Chromobacterium, Cytophaga, Sporocytophaga, and Cellvibrio cultures. A 97-98% recovery is achieved after a short period of adaptation of the sludge. The method prevents for-

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mation of viscose sludges and atmospheric contamination by toxic gases. (Collins-FIRL)  
W77-04459

#### RECOVERING POLYVINYL ALCOHOL FROM WASTE WATER BY COAGULATING WITH BORATE AND INORGANIC SALT IN PRESENCE OF QUATERNARY AMMONIUM COMPOUND TO REDUCE WATER CONTENT OF GEL.

Belgian Patent BE 842-518. Issued October 1, 1976. Belgian Patents Abstracts, Vol. X, No. 43, p D4, December, 1976.

Descriptors: \*Patents, \*Chemical oxygen demand, \*Treatment facilities, \*Alcohols, Waste water (Pollution), Coagulation, Salts, \*Waste water treatment, Industrial wastes.

Identifiers: Polyvinyl alcohol.

A patent was issued for a process and apparatus to recover polyvinyl alcohol from waste water of textile-finishing operations and to reduce COD. Polyvinyl alcohol is separated and recovered from aqueous solutions through the addition of boric acid or a borate; an inorganic salt, hydrated Na<sub>2</sub>SO<sub>4</sub>; and a cationically-active quaternary ammonium base or its salt (0.005-0.1% of aqueous solution). The pH is adjusted to 8-10 to coagulate polyvinyl alcohol as a gel. Addition of the ammonium base or its salt converts the coagulated matter to a less voluminous form with lower water and salt content. (Collins-FIRL)  
W77-04460

#### POLLUTION CONTROL IN THE TEXTILE INDUSTRY (EXEMPLE D'ACTION DANS L'INDUSTRIE TEXTILE), C. Peker.

Annales des Mines, Vol. 182, No. 11, p 33-36, November, 1976. 2 tab.

Descriptors: \*Waste water treatment, \*Biochemical oxygen demand, \*Treatment facilities, \*Textiles, Industries, Water pollution control, Water purification, \*Industrial wastes.

Identifiers: \*Textile industry.

Due to the complete absence of purification installations in the textile industry in the Rhine-Meuse basin, a pollution control program was developed in May 1975. The program became effective January 1976. Thirty-nine of forty-six eligible plants have signed contracts with the Financial Rhine-Meuse Agency. The large installations being helped by the Agency have two years to determine which processes they will use. Plants which produce over 15 tons of textile per day will have to reduce organic pollution by 95% and remove color from the effluents almost completely. Within five years, the volume of effluents to be purified should have decreased from 50,000 cu m/day to 10,000 cu m/day. The present daily load of 19.3 tons of BOD<sub>5</sub> should be eliminated completely, as well as colorant pollution. (Waltner-FIRL)  
W77-04461

#### GAME THEORY APPROACH TO DESIGN UNDER UNCERTAINTY, Brookhaven National Lab., Upton, N. Y.

P. M. Meier.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 103, No. EE1, Proceedings paper No. 12759, p 99-111, February 1977. 7 fig, 3 tab, 18 ref.

Descriptors: \*Pollution abatement, \*Waste water treatment, \*Sewage treatment, Design, Facilities, Management, Investment, Mathematical models, Planning, Optimization, Treatment facilities, Economies of scale, Decision making, Methodology, Stochastic processes, Systems analysis, Equations.

Identifiers: \*Game theory, \*Uncertainty principle, \*Cost effectiveness, Penalties, Underdesign, Overdesign.

Using some basic concepts from game theory, a framework for the analysis of pollution control investments under uncertainty is developed. Considered is the design of a wastewater treatment plant, given a probabilistic flow projection as the fundamental input. Gasting the facility designer and nature as the participants in a two-person zero-sum game, and formulating the cost penalties for making incorrect projections as the pay-off matrix, a rational method for determination of the optimal design specification for plant expansions is derived. The relationship between projection uncertainty, interest rates, and scale economies receives particular attention. The optimum design strategy is to select the design flow that corresponds to the minimum expected penalty. The method is applied to some recent sewage treatment plant projects, with the results compared to the more traditional design specifications contained in the preliminary design reports. Under the prevailing interest rate conditions, overdesign in the face of flow uncertainty is shown to carry higher economic penalties than underdesign. (Bell-Cornell)  
W77-04504

#### INVENTORY OF WASTE WATER PRODUCTION AND WASTE WATER RECLAMATION IN CALIFORNIA 1973.

California Dept. of Water Resources, Sacramento. Water Quality Section. Bulletin No. 68-73, April 1975. 32 p. 1 fig., 3 tab, \$1.50.

Descriptors: \*California, \*Surveys, \*Water reuse, \*Reclaimed water, Water utilization, Waste water disposal, Data collections, Waste water treatment.

Production, reclamation, and disposal of waste water information by 623 municipal treatment plants, 74 federal installations, and 202 private enterprises in California for 1973 is reported. Waste water reclamation data is broken down into the 11 hydrologic study areas of the state, and include the annual quantity in acre-feet of waste water produced, waste water reclaimed by either planned or incidental means, and net waste water discharged. Also reported are the estimated population served, the uses of the reclaimed water, and the place of discharge. General uses were crop, landscape and golf course irrigation; industrial and recreational use; and groundwater recharge. Results show that most of the waste water in the inland study areas is being reclaimed by planned or incidental means, and that the principal opportunities for additional reclamation are in coastal areas. Approximately 70% of the waste water produced was discharged into saline waters where it was lost to further reuse. Reclamation of these waters could add more than 1.8 million acre-feet in new water supply. (Luedtke-Wisconsin)  
W77-04558

#### SANITARY-CHEMICAL EVALUATION OF CELLULOSE ACETATE MEMBRANES USED FOR DESALINATION OF SEA WATER, (IN RUSSIAN),

Scientific Research Inst. of Water Transport Hygiene, Moscow (USSR). For primary bibliographic entry see Field 3A.  
W77-04596

### 5E. Ultimate Disposal Of Wastes

EFECTS OF AGRICULTURAL PRACTICES AND LAND DISPOSAL OF SOLID WASTE ON QUALITY OF WATER FROM SMALL WATERSHEDS, Tennessee Univ., Knoxville. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 5B.

W77-04102

POTENTIAL REPLACEMENT OF SEPTIC TANK DRAIN FIELD BY ARTIFICIAL MARSH WASTE WATER TREATMENT SYSTEMS, Wisconsin Univ.-Oshkosh. Dept. of Geology. For primary bibliographic entry see Field 5D.  
W77-04117

LEACHATE DAMAGE ASSESSMENT, CASE STUDY OF THE PEOPLES AVENUE SOLID WASTE DISPOSAL SITE IN ROCKFORD, ILLINOIS, Environmental Protection Agency, Cincinnati, Ohio. Office of Solid Waste Management Programs. For primary bibliographic entry see Field 5B.  
W77-04122

THE GEOLOGIC ASPECTS IN THE PLANNING AND IMPLEMENTATION OF THE PENNSYLVANIA SOLID WASTE MANAGEMENT ACT, ACT 241, Pennsylvania Dept. of Environmental Resources, Harrisburg. For primary bibliographic entry see Field 5G.  
W77-04125

GENERATION OF LEACHATE FROM LANDFILLS AND ITS SUBSURFACE MOVEMENT, Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management. For primary bibliographic entry see Field 5B.  
W77-04134

OCEAN DUMPING; PROPOSED REVISION OF REGULATIONS AND CRITERIA, Environmental Protection Agency, Washington, D.C. For primary bibliographic entry see Field 5G.  
W77-04372

ENVIRONMENTAL PROTECTION AGENCY: GENERAL PERMITS FOR THE TRANSPORTATION FOR DUMPING, AND THE DUMPING OF MATERIAL INTO OCEAN WATERS, Environmental Protection Agency, Washington, D.C. For primary bibliographic entry see Field 5G.  
W77-04375

ENTERIC VIRUS REMOVAL FROM SEPTIC TANK EFFLUENT BY PILOT SCALE SOIL ABSORPTION SYSTEMS, North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering. For primary bibliographic entry see Field 5D.  
W77-04389

THE SURVIVAL OF SEWAGE BACTERIA AT VARIOUS OCEAN DEPTHS, Civil Engineering Lab. (Navy), Port Hueneme, Calif. For primary bibliographic entry see Field 5B.  
W77-04491

A COST-EFFECTIVE SATELLITE-AIRCRAFT-DROGUE APPROACH FOR STUDYING ESTUARINE CIRCULATION AND SHELF WASTE DISPERSION, Delaware Univ., Newark. Coll. of Marine Studies. For primary bibliographic entry see Field 5B.  
W77-04492

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Quality Control—Group 5G

**DISCHARGE OF TREATED WASTEWATER IN LAKES, (IN GERMAN).**  
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).  
For primary bibliographic entry see Field 5B.  
W77-04595

#### 5F. Water Treatment and Quality Alteration

**PRELIMINARY ASSESSMENT OF SUSPECTED CARCINOGENS IN DRINKING WATER, REPORT TO CONGRESS.**  
Environmental Protection Agency, Washington, D.C. Office of Toxic Substances.  
For primary bibliographic entry see Field 5A.  
W77-04135

**EXPLAINING VARIATIONS IN CARDIOVASCULAR DISEASE MORTALITY WITHIN A SOFT WATER AREA,**  
Massachusetts Univ., Amherst. School of Health Sciences.  
For primary bibliographic entry see Field 5C.  
W77-04295

**WATER OZONATION IN FISH CULTURE, (IN GERMAN),**  
Kanton Fischerei und Jagdverwaltung, Zurich (Switzerland).  
M. Straub.  
Schweiz Z Hydrol 37(2), p 289-293, 1975.

Descriptors: \*Ozone, Fish, \*Brown trout, Fish hatcheries, Bacteria, Breeding, Eggs, \*Water treatment.  
Identifiers: \*Ozonation, \*Switzerland.

Because of the installation of an ozonizer, the heavy loss of brown trout eggs, at the Greifensee (Switzerland) fish hatchery was significantly reduced. Breeding and hatching yields were equally high regardless of whether the water was treated with malachite green or ozone; both types of water treatment gave better results than untreated crude water from the Greifensee. The bacteria count in breeding water with ozone is very low. If fry is transferred directly to lake water without gradual adaptation to the higher bacteria count characteristic of natural waters, the effectiveness of water treatment measures to improve hatch yields is jeopardized.—Copyright 1976, Biological Abstracts, Inc.  
W77-04591

#### 5G. Water Quality Control

**ESTUARINE POLLUTION, A BIBLIOGRAPHY, VOLUME 2.**  
Office of Water Research and Technology, Washington, D.C.  
For primary bibliographic entry see Field 5B.  
W77-04109

**ESTUARINE POLLUTION, A BIBLIOGRAPHY, VOLUME 3.**  
Office of Water Research and Technology, Washington, D.C.  
For primary bibliographic entry see Field 5B.  
W77-04110

**THE GEOLOGIC ASPECTS IN THE PLANNING AND IMPLEMENTATION OF THE PENNSYLVANIA SOLID WASTE MANAGEMENT ACT, ACT 241,**  
Pennsylvania Dept. of Environmental Resources, Harrisburg.  
G. L. Merritt, and W. C. Bucciarelli.  
1971, p 21, 15 fig, 5 tab, 7 ref.

Descriptors: \*Legislation, \*Water pollution control, \*Waste disposal, Landfills, \*Pennsylvania, \*Solid wastes, Pollution abatement.  
Identifiers: \*Solid Waste Act, Act 241, \*Solid waste management.

The Solid Waste Act, Act 241, for Pennsylvania, was signed in 1970, with the ultimate goal of the elimination existing and prevention of further environmental pollution. Act 241 requires planning, implementation of approved plans, and enforcement of standards, rules, and regulations. It encourages this accomplishment on a regional basis within a waste management concept. This is the initial step in the total regionalization of solid waste management in Pennsylvania and calls the establishment of 11 regional councils to guide, develop, continuously plan, and update the solid waste management systems in the regions. At present, and continuing through the early 1980's, the principle method of disposing of solid wastes will be sanitary landfills. This places the pollution burden of solid waste disposal on the land itself. The concept by which this pollution burden (leachate) is managed is dependent upon the soils and hydrogeologic conditions of the proposed waste disposal sites. There are two concepts for managing the leachate: (1) the natural renovation of leachate by the underlying earth materials; or (2) the collection and treatment of leachate. Each concept requires basic and hydrogeologic criteria which must be met. (Grober-NWWA)  
W77-04125

**EVALUATING WELL CONSTRUCTION,**  
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.  
For primary bibliographic entry see Field 8B.  
W77-04131

**WELL CONSTRUCTION AND WATER QUALITY,**  
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.  
E. J. Jones.

Presented at 1971 Winter Meeting of American Society of Agricultural Engineers, December 6-10, 1971, Sherman House, Chicago, Illinois, p 15, 15 fig, 2 tab, 3 ref.

Descriptors: \*Water wells, Construction materials, Casings, Concrete placing, Water pollution.  
Identifiers: \*Water well rehabilitation, \*Water well construction, Pitless adapters, Casing splicing.

Wells lacking adequate sanitary protection serve as unauthorized, uncontrolled ground-water recharge points. Some common, easily detected sanitary defects such as loose fittings, corroded casing, damaged well slabs and casing splicing will allow contaminated surface water to enter the wellbore unchecked. Wells suffering from contamination due to these structural problems can be reconstructed to provide good quality water. The diagnosis and treatment of the specific problems are the key to proper water well rehabilitation. (Heiss-NWWA)  
W77-04132

**SYSTEM PREVENTS LEACHATE FORMATION.**  
Water and Wastes Engineering, Vol. 13, No. 10, p 26, October, 1976, 1 fig.

Descriptors: \*Landfills, Water pollution, Groundwater, Infiltration, Plastics, Pollution abatement, \*Delaware, \*Leachate.  
Identifiers: Spunbonded polypropylene, Multilayered sanitary landfills, Milled trash.

A new system to help prevent contamination of groundwater by sanitary landfill leachate is being evaluated by the Department of Public Works of New Castle County, Delaware. The system uses

an impervious cover of Tyvar spunbonded polypropylene coated with polypropylene to minimize infiltration of precipitation and thereby reduce leachate production. Used in combination with milled trash, the cover is said to eliminate the need for soil cover. The program involves building a multilayered landfill using sheets of the coated polypropylene. After the first sheet of plastic has been layer of milled trash is deposited and spread by bulldozer. While the trash is being spread, a new roll of covering is placed to overlap the sheet already in position. The sheets are joined by strips of tape spaced to allow gases to escape. This shingle effect allows the formation of a gradual slope which allows water to run off the landfill, hence reducing infiltration and leachate production. (Heiss-NWWA)  
W77-04136

**SUMMARY OF SELECTED COURT CASE IN WATER CONSERVATION AND GROUND-WATER LITIGATION,**  
Arizona Univ., Tucson.  
For primary bibliographic entry see Field 6E.  
W77-04139

**PROCEEDINGS: BIOSTIMULATION AND NUTRIENT ASSESSMENT WORKSHOP.**  
Pacific Northwest Environmental Research Lab., Corvallis, Oreg.  
For primary bibliographic entry see Field 5C.  
W77-04153

**ALTERNATIVE METHODS OF FINANCING WASTEWATER TREATMENT,**  
Environmental Protection Agency, Washington, D.C. Office of Planning and Evaluation.  
W. Smith, D. Hale, M. Rose, and J. Goldstein.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 305, Price codes: A07 in paper copy, A01 in microfiche. Report No. EPA-230/3-76-002, October 1975. 135 p. 9 tab., 21 ref., 3 append.

Descriptors: \*Waste water treatment, \*Financing, \*Loans, \*Grants, Federal Water Pollution Control Act, Government finance, Credit, Participating funds, Bond issues, Capital, Economics, Costs.  
Identifiers: \*Environmental trust fund, \*Environmental loan program.

Because of various limitations and constraints, only three basic options are considered viable by the Environmental Protection Agency for financing the costs of water pollution abatement: (1) improvements to the existing Construction Grants Program; (2) development of an environmental trust fund; and (3) creation of an environmental loan program. Description is given of the current grant program, including authorizations, allotments, the planning and grant approval cycle, and eligibilities. Possible improvements to the current program would include changes in the allotment and grant process, and manipulation of grant conditions and elements. Environmental trust funds, if used, could be either 'open' or 'closed,' i.e., with or without a designated supply of funds and a defined end use. Analysis is given for possible trust fund monetary sources, disbursement procedures, projected economic effects, effectiveness and feasibility. An environmental loan program, if used, would involve low-interest federal loans as an alternative—not a supplement to the existing grant program. Consideration is given to revenue sources, financial equivalence of loans and grants, administrative requirements, and economic/financial effects. (Harris-Wisconsin)  
W77-04167

**THE LAKE TAHOE STUDY...AS REQUESTED BY THE 92ND CONGRESS IN SECTION 114 OF THE FEDERAL WATER POLLUTION CONTROL ACT OF 1972.**  
Environmental Protection Agency, San Francisco, Calif. Surveillance and Analysis Div.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 153, Price codes: A07 in paper copy, A01 in microfiche. (1975). 145 p, 12 fig., 9 tab., 109 ref.

Descriptors: \*Land use, \*Watershed management, \*Comprehensive planning, Basins, Lakes, California, Nevada, Water resources development, Water management(Applied), Multiple-purpose projects, Regional development, Federal Water Pollution Control Act, Ecosystems, Water pollution control, Erosion control, Interstate compacts, Condemnation, Condemnation value, Institutions. Identifiers: \*Lake Tahoe Basin(Calif-Nev).

An important conclusion reached by a comprehensive study of the Lake Tahoe Basin in 1973 and 1974 was that, while federal oversight and control in efforts to preserve the fragile ecology of the lake are adequate in terms of public lands around the lake, such efforts are inadequate for control of the activities connected with private lands. As a corollary, it was concluded that legal and other arrangements should be redefined to resolve the apparent dichotomy of adequacy. Various recommendations were given to resolve this problem, including individual actions that could be taken by the U.S. Congress and by the States of California and Nevada. Study elements described include a basic 9-point description of the Tahoe basin, including location, physical geography, political geography, status of planning, land ownership and land use, economic system, population, infrastructure, and externalities. The Tahoe Basin ecosystem and intergovernmental activities relating to it are also considered, including compact provisions and federal coordination, an analysis of agency activities and intergovernmental problems relating to federal policy, sewerage, air quality, erosion and sedimentation control, water supply, transportation, regulation of private development and ecosystem management. Also described are an assessment of the adequacy of federal control and a roster of programs available to resolve basin problems. (Harris-Wisconsin) W77-04168

**POLLUTION ABATEMENT AND REGIONAL WELFARE: A CONTROL THEORY APPROACH,**  
State Univ. of New York at Binghamton.  
For primary bibliographic entry see Field 6G.  
W77-04169

**THE EXTENT TO WHICH MARINE TRANSPORTATION WITHIN THE ECONOMIC ZONE WILL BE AFFECTED BY ENFORCEMENT OF THE PROPOSED POLLUTION CONTROLS,**  
Woods Hole Oceanographic Institution, Mass. Dept. of Applied Oceanography.  
N. W. Graham.  
Technical Report No. WHOI-76-95, October 1976. 16 p. SG-04-6-158-44016.

Descriptors: \*Transportation, \*Economics, \*Environmental effects, \*Jurisdiction, \*International law, \*Water pollution control, International waters, Legal aspects, Ice cover, Law of the sea.  
Identifiers: Environmental protection, Pollution controls.

This study provides a detailed analysis of the provisions of Chapter I, Part III of the Single Revised Negotiating Text, which was produced at the Fourth Session of the Third United Nations Conference on the Law of the Sea. The purpose of the analysis is to determine how navigation will be restricted in the proposed economic zone because of controls relating to pollution or preservation and protection of the marine environment. The conflict created in the negotiation concerning the content of the regulation results from the differing interests of the maritime powers, states which border on international straits, and other states with a strong interest in protection of the marine

environment. The present compromise states that if a violation is believed to occur in the economic zone the vessel may be the subject of inquiry; however, it may continue its voyage. Proceedings may be initiated for flagrant violation of international standards which cause major damage or the threat of major damage. However, in most cases physical detention of the vessel may be avoided through action by the flag state. (NOAA) W77-04194

#### WORKSHOP REPORT INTEGRATING WATER QUALITY AND WATER AND LAND RESOURCES PLANNING.

For primary bibliographic entry see Field 6B.  
W77-04202

#### SYMPOSIUM, THE FUTURE OF CHESAPEAKE BAY.

For primary bibliographic entry see Field 6G.  
W77-04203

#### PROCESS AND ENVIRONMENTAL TECHNOLOGY FOR PRODUCING SNG AND LIQUID FUELS,

For primary bibliographic entry see Field 3E.  
W77-04204

#### AMMONIA LOSSES ON UREA FERTILIZATION I. MODEL EXPERIMENTS ON AMMONIA VOLATILIZATION AS INFLUENCED BY SOIL PH VALUE, EXCHANGE CAPACITY, TEMPERATURE AND WATER CONTENT, (IN GERMAN),

Deutsche Akademie der Landwirtschaftswissenschaften zu Berlin, Leipzig (East Germany). Institut fuer Duengungsforschung.

For primary bibliographic entry see Field 2G.  
W77-04208

#### A DYNAMIC BALANCED REGIONAL INPUT-OUTPUT MODEL OF POLLUTION CONTROL,

State Univ. of New York at Binghamton. School of Management.  
M. Chatterji.

Environment and Planning, Vol. 7, p 21-34, 1975. 1 fig, 9 ref.

Descriptors: \*Input-output, \*Environmental control, \*Economics, \*Economic aspects, \*Population, \*Migration, \*Capital mobility, \*Capital supply, \*Unemployment, Analytical techniques, Environmental quality, Pollution, Model studies.

Identifiers: \*Environmental management, \*National goods, \*Regional goods, Local goods.

A balanced input-output model is presented to identify responsibility for pollution generation and control, specifically applicable when several regions are contained within a single nation. Pollution is generated in one area due to the requirement of inputs, directly or indirectly, for final consumption demand in another area. In principle, the consuming region should pay to clean up environmental pollution in the producing area. To this end, prices (and/or taxes) are fixed on goods in different regions in order to maximize the general welfare in each region. There are two ways to control pollution: (1) to slow the rate of growth; (2) to change the location of mobile national industries (as opposed to local or regional industries) through incentives and sanctions. Only the second alternative is politically feasible. Pollution control affects the comparative advantage the region holds in producing national goods. Consequently the national industries relocate in another region if pollution control devices must be installed, resulting in increased unemployment in the region, altered inter-regional migration patterns, and capital movements over space. Dynamic balance equations are presented showing the amount of environmental damage caused by a unit production

of regional and national goods presently produced in a region. The model presented suggests a means to calculate the equilibrium production levels in different regions of the country, given technological constraints and external policy decisions. (Gentry-NC) W77-04209

#### HYDROLOGY OF SALINE SEEPES IN THE NORTHERN GREAT PLAINS,

Agricultural Research Service, Mandan, N. Dak.

Northern Great Plains Research Center.

E. J. Doering, and F. M. Sandoval. Transactions of the American Society of Agricultural Engineers, Vol. 19, No. 5, p 856-861, 865, September-October 1976. 7 fig, 4 tab, 16 ref.

Descriptors: \*Seepage, \*Groundwater movement, \*Water quality, \*Seepage control, \*North Dakota, On-site investigations, On-site tests, Measurement, Instrumentation, Saline water, Salinity, Nitrates, Chlorides, Hydrographs, Hydrology, Groundwater, Subsurface drainage, Tile drainage, Hydrologic data.

Hydrologic data collected between 1970 and 1975 show: (1) that saline seeps are sustained by local recharge, i.e., by soil water that percolates past the root zone of the adjacent upslope landscape, (2) that seep development is closely related to recent climatic and cultural events, and (3) that hydraulic control can be quickly accomplished with interceptor drains. Effluents from two drains were saline, with nitrate concentrations consistently high enough to be hazardous to health of humans and livestock. (Humphreys-ISWS) W77-04268

#### DON'T LET THE BUGS GET THE BEST OF YOU,

National Water Well Association, Worthington, Ohio.

For primary bibliographic entry see Field 8G.  
W77-04281

#### A STUDY OF TUBEWELL INSTALLATIONS IN BETUL DISTRICT MADHYA PRADESH, INDIA,

E. L. C. Water Development Project, Betul (India).

For primary bibliographic entry see Field 8B.  
W77-04284

#### LAND USE PATTERNS, EUTROPHICATION AND POLLUTION IN SELECTED LAKES,

Vermont Univ., Burlington. Dept. of Agricultural and Resources Economics.

For primary bibliographic entry see Field 5C.  
W77-04298

#### BENEFITS FROM WATER POLLUTION ABATEMENT, RECREATION.

National Planning Association, Washington, D.C. Available from the National Technical Information Service, Springfield, VA 22161 as PB-252 283, Price codes: E15 in paper copy, A01 in microfiche.

National Commission on Water Quality, Washington, D.C., Report NCWQ, 75/40, November 1975. 2 volumes, appendices, 1, 135 p. WQSACO26.

Descriptors: \*Federal Water Pollution Control Act, Forecasting, Water pollution control, Estimating, \*Benefits, \*Fishing, \*Swimming, \*Recreation, Water pollution, \*Pollution abatement.

Identifiers: \*Federal Water Pollution Control Act Amendments of 1972.

Implementation of the Federal Water Pollution Control Act will bring about substantial improvement in water quality and equally substantial increases in public's participation. For boating, improved water quality resulting from implementing

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the law is expected to increase annual participation days by 8.6 percent in 1980 and 10.3 percent in 1985. For sport fishing, increases are estimated at 5.9 percent by 1980 and 6.3 percent by 1985. Increases will be more significant in some areas than in others, depending upon water quality improvements, age and sex characteristics of the population and other factors. (NCWQ)

W77-04299

#### WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: CATEGORY 29 INSULATION FIBERGLASS.

Battelle Memorial Inst., Columbus, Ohio.  
National Commission on Water Quality, Washington, D.C., Report NCWQ 75/89-Vol 4, July 1975. 728 p. WQ5AC012.

Descriptors: \*Industrial wastes, Waste disposal, \*Water pollution control, \*Insulation, Operating costs, Capital costs, Performance.

Identifiers: \*Insulation fiberglass, \*Glass industry, \*Federal Water Pollution Control Act Amendments of 1972.

Technologies are examined for thirty eight (38) industry segments to meet water pollution abatement requirements of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500); insulation fiberglass was the industry category selected. Levels of pollution abatement which are reviewed include those promulgated by the U.S. Environmental Protection Agency for 1977 (PBCTCA or best practicable control technology currently available) and for 1983 (BATEA or best available technology economically achievable). Capital and operating and maintenance costs are presented in 1973 dollars. Performance is stated in terms of resulting effluents. (NCWQ)

W77-04300

#### WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: CATEGORY 16 PAINT AND INK FORMULATION AND PRINTING.

Battelle Memorial Inst. Columbus, Ohio.  
National Commission on Water Quality, Washington, D.C., Report NCWQ 75/89-Vol 3, July 1975. 616 p. WQ5AC012.

Descriptors: \*Industrial wastes, Waste disposal, \*Water pollution control, \*Paints, Operating costs, Capital costs, Performance.

Identifiers: \*Ink formulation and printing, \*Federal Water Pollution Control Act Amendments of 1972.

Technologies are examined for thirty eight (38) industry segments to meet water pollution abatement requirements of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500); paint and ink formulation and printing was the industry category selected. Levels of pollution abatement which are reviewed include those promulgated by the U.S. Environmental Protection Agency for 1977 (PBCTCA or best practicable control technology currently available) and for 1983 (BATEA or best available technology economically achievable). Capital and operating and maintenance costs are presented in 1973 dollars. Performance is stated in terms of resulting effluents. (NCWQ)

W77-04301

#### WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES CATEGORY 7, DAIRY PRODUCTS.

Battelle Memorial Inst., Columbus, Ohio.  
National Commission on Water Quality, Washington, D.C., Report NCWQ 75/89-Vol 2, July 1975. 652 p. WQ5AC012.

Descriptors: \*Industrial wastes, Waste disposal, Water pollution control, \*Dairy industry, Milk, Capital costs, Operating costs, Performance.  
Identifiers: \*Dairy products, \*Federal Water Pollution Control Act Amendments of 1972.

Technologies are examined for thirty eight (38) industry segments to meet water pollution abatement requirements of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500); dairy products was the industry category selected. Levels of pollution abatement which are reviewed include those promulgated by the U.S. Environmental Protection Agency for 1977 (PBCTCA or best practicable control technology currently available) and for 1983 (BATEA or best available technology economically achievable). Capital and operating and maintenance costs are presented in 1973 dollars. Performance is stated in terms of resulting effluents. (NCWQ)

W77-04302

#### WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: INDUSTRY CATEGORY 1A, ORE MINING AND MILLING.

Battelle Memorial Inst., Columbus, Ohio.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 437, Price codes: E99 in paper copy, A01 in microfiche. National Commission on Water Quality, Washington, D.C., Report NCWQ 75/89-Vol 1, July 1975. 607 p. WQ5AC012.

Descriptors: \*Industrial wastes, Waste disposal, \*Water pollution, \*Mining, Operating costs, Capital costs, Performance, Mine wastes.

Identifiers: \*Ore mining and milling, \*Federal Water Pollution Control Act Amendments of 1972.

Technologies are examined for thirty eight (38) industry segments to meet water pollution abatement requirements of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500); ore mining and milling was the industry category selected. Levels of pollution abatement which are reviewed include those promulgated by the U.S. Environmental Protection Agency for 1977 (PBCTCA or best practicable control technology currently available) and for 1983 (BATEA or best available technology economically achievable). Capital and operating and maintenance costs are presented in 1973 dollars. Performance is stated in terms of resulting effluents. (NCWQ)

W77-04303

#### WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, DIRECT AND CUMULATIVE INDUSTRY IMPACTS.

Development Planning and Research Associates, Inc., Manhattan, Kans.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 224, Price codes: A08 in paper copy, A01 in microfiche. National Commission on Water Quality, Washington, D.C. Report NCWQ 75/75, November 1975. 175 p. WQ5AC011.

Descriptors: Pollution abatement, Forecasting, Federal Water Pollution Control Act, \*Economic impacts, Water pollution control, \*Food industry, \*Industries, \*Food processing.

Identifiers: \*Federal Water Pollution Control Act Amendments of 1972, Water pollution abatement.

Authors summarize the economic impacts of the 1977 (BPT) and 1983 (BAT) requirements of the 1972 Federal Water Pollution Control Act Amendments on selected food industries. Industry-wide direct and cumulative interindustry impacts were assessed. Cumulative retail price and quantity impacts for beef, poultry, pork and processed fruits and vegetables are expected to be modest. Incrementally, BPT control levels are expected to result in greater retail impacts than BAT. Retail impacts stemming from pollution control in industries

which perform initial supplying and producing functions will be less severe than price impacts stemming from final processing industries. Retail price impacts on plants serviced by public waste treatment systems will be significant. Authors estimate net capital investment for pollution controls along with operating and maintenance costs. (NCWQ)

W77-04304

#### WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, STATE AND LOCAL REVENUE EXPENDITURES.

Data Resources, Inc., Washington, D.C.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-250 018, Price codes: A99 in paper copy, A01 in microfiche. National Commission on Water Quality, Washington, D.C., Report NCWQ 75/41, October 1975. 740 p. WQ5AC084.

Descriptors: Pollution abatement, \*Economic impacts, Revenue, Federal Water Pollution Control Act, Expenses, \*Financing, \*State governments, \*Local governments, Construction costs, Estimating, \*Cost estimates.

Identifiers: Federal Water Pollution Control Act Amendments of 1972, Water pollution abatement.

With the passage of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), state and local governments became responsible for upgrading sewage treatment facilities in their jurisdictions to the level of at least secondary treatment. Authors estimate which governments will and will not be able to afford the water treatment projects required under the Act without increasing revenues, incurring deficits or decreasing expenditures. Of fifty state governments, fifty local aggregates and the District of Columbia an estimated ten states and twenty local aggregates will not be able to afford to meet the requirements of the law. Those places which cannot afford to meet the requirements of the law are places where either taxes will have to be raised significantly faster than otherwise would be the case or where other expenditure items will have to be markedly reduced to achieve compliance with the Act. (NCWQ)

W77-04305

#### WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, INCIDENCE OF COSTS, DISTRIBUTION OF WATER POLLUTION CONTROL COSTS.

Urban Systems Research and Engineering, Inc., Cambridge, Mass.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-253 065, Price codes: A21 in paper copy, A01 in microfiche. National Commission on Water Quality, Washington, D.C. Report NCWQ 75/110, March 1976. 496 p. WQ5AC001.

Descriptors: \*Water pollution control, Pollution abatement, Federal Water Pollution Control Act, Water law, \*Economic impacts, Forecasting, \*Costs, \*Cost analysis.

Identifiers: \*Federal Water Pollution Control Act Amendments of 1972, Water pollution abatement.

The direct economic incidence of the costs of meeting the effluent limitations requirements, including industrial and municipal requirements of Public Law 92-500, are assessed. Many local governments and private industries will install new treatment facilities in response to the 1972 Amendments to the Water Pollution Control Act. In the final analysis, individual Americans will pay the costs of these facilities in many ways; through higher taxes, reduced public services and increased prices for the goods consumed. Pollution control burdens for the average family total approximately \$208, or 1.14% of total family income, in 1977; \$368, or 1.84%, in 1980; and \$539, or 2.43%, in 1985. Because of the relatively small size

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of this burden, no major distributional impacts are anticipated. All costs in 1973 dollars. (NCWQ) W77-04306

#### PUBLIC LAW 92-500 ECONOMIC AND SOCIAL IMPACTS: TECHNICAL VOLUME.

National Commission on Water Quality, Washington, D.C.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-253 037. Price codes: A99 in paper copy, A01 in microfiche. Report NCWQ 75/111, April 1976. 4 volumes, 1,602 p.

Descriptors: \*Economic impacts, \*Social impacts, Economics, Water quality, \*Benefits, Federal Water Pollution Control Act, Water pollution control, Pollution abatement, \*Water law, Federal programs.

Identifiers: \*Federal Water Pollution Control Act Amendments.

This report is a replication of Chapter III, The Economics of Water Quality, from the Commission's Staff report, with 21 Appendices attached which provide supplemental technical material as a further amplification of that Chapter. This volume serves as a condensation of all staff and contractor work done in support of Chapter III. (NCWQ) W77-04307

#### AN ANALYSIS OF U.S. ENVIRONMENTAL PROTECTION AGENCY'S NEEDS SURVEY,

American Public Works Association, Chicago, Ill.

R. H. Sullivan, and M. B. Cohn.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-244 803. Price codes: A15 in paper copy, A01 in microfiche. National Commission on Water Quality, Washington, D.C. Report NCWQ 75/07, August 1975. 324 p., 100 tab, 2 append. WQ4AC014.

Descriptors: \*Combined sewers, \*Waste water treatment, \*Treatment facilities, Grants, Federal Water Pollution Control Act, Financing, Sewage treatment, Sewers, Sludge disposal, Storm sewers, Water pollution control, Water quality. Identifiers: Federal Water Pollution Control Act Amendments of 1972, Water pollution control.

Representatives of states and major municipalities were asked how they based their construction cost estimates for publicly owned wastewater treatment works which they submitted for the U.S. Environmental Protection Agency's 1974 needs survey, as required by Section 516 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). Sources of understated costs included high population estimates, lack of cost-effectiveness analysis, and the assumption that sewer separation is the principal solution to combined sewer overflow problems. Possible reasons for understated costs were missing entries and omission of sludge disposal costs. Areas of uncertainty included incomplete sewer system evaluation, availability of stormwater control technology, and accuracy of assumptions concerning required effluent quality. Additional information was obtained on funding, unreported needs and construction progress. (NCWQ) W77-04308

#### WATER POLLUTION CONTROL ACT OF 1972 REGIONAL IMPACTS HOUSTON SHIP CHANNEL/GALVESTON BAY.

Johnson (Bernard), Inc., Houston, Tex.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-252 460. Price codes: A99 in paper copy, A01 in microfiche.

National Commission on Water Quality, Washington, D.C. Report NCWQ 75/29, August 1975. 3 volumes, 922 p. WQ5AC059.

Descriptors: River basins, \*Texas, \*Channels, Bays, Inland waterways, Water pollution control, Environmental effects, Pollution abatement, Federal Water Pollution Control Act, Water law, Economics, Forecasting.

Identifiers: \*Federal Water Pollution Control Act Amendments of 1972, Water pollution abatement, \*Houston Ship Channel/Galveston Bay(Tex).

The environmental, social, economic and institutional impacts of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) on the Houston Ship Channel/Galveston Bay are reviewed. The study area includes Harris, Galveston, Chambers and parts of Brazoria counties.

Three levels of abatement, BPT (best practicable control technology), BAT (best available technology) and EOD (elimination of the discharge of pollutants) are reviewed. Growth in population, number of households, number of jobs and available labor force will be enhanced by the 1977 (BPT) and 1983 (BAT) standards of the law. Authors suggest withdrawal of the 1985 EOD goal in light of its high cost and marginal effect on the social, ecological, and economic fabric of the study area. (NCWQ) W77-04309

#### WATER POLLUTION CONTROL ACT OF 1972, REGIONAL IMPACTS, MERRIMACK-NASHUA RIVER BASIN.

Abt Associates, Inc., Cambridge, Mass.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-250 060. Price codes: A99 in paper copy, A01 in microfiche. National Commission on Water Quality, Washington, D.C. Report NCWQ 75/32, November 1975. 2 volumes, 302 p. WQ5AC014.

Descriptors: River basins, Federal Water Pollution Control Act, \*Regions, \*New Hampshire, \*Massachusetts, Water pollution control, Pollution abatement, Regional analysis, Environment effects, Water law, Economics, Forecasting.

Identifiers: Federal Water Pollution Control Act Amendments of 1972, Water pollution abatement, \*Merrimack-Nashua River Basin.

The environmental, economic, social and institutional impacts of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) on the Merrimack/Nashua River Basin are reviewed. The study area includes the Merrimack mainstem in Massachusetts and New Hampshire and its principal tributary, the Nashua River. Inventory of present discharges, a projection of future wasteloads and an assessment of abatement costs for four levels of abatement, including those promulgated or proposed by the U.S. Environmental Protection Agency, are presented. Projected changes in water quality and resulting biologic impacts and benefits are given. An examination of existing and future institutional arrangements necessary to implement the law is presented. Eight facilities were surveyed to determine abatement costs and economic impacts. (NCWQ) W77-04310

#### BASELINE STUDIES OF DELAWARE OCEAN OUTFALL SITES,

Delaware Univ., Lewes. Coll. of Marine Studies. For primary bibliographic entry see Field 5A. W77-04330

#### EXAMINATION OF THE FLUORIDE CONCENTRATION IN DRINKING WATER OF THE TOWN OF TITOGRAD, (IN SERBO-CROATIAN),

Meditinski Institut, Titograd (Yugoslavia).

For primary bibliographic entry see Field 5A. W77-04334

#### MOBILE METHOD OF DETERMINING FLUORIDES IN DRINKING WATER, (IN RUSSIAN),

Central Lab. of the Waterworks Administration, Yaroslavl (USSR).

For primary bibliographic entry see Field 5A. W77-04337

#### FARMERS, FEEDLOTS AND FEDERALISM: THE IMPACT OF THE 1972 FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS, Stanford Univ., Calif. School of Law.

N. W. Hines.

South Dakota Law Review, Vol. 19, p. 540-66 (1974).

Descriptors: \*Agricultural runoff, \*Federal Water Pollution Control Act, \*Farm wastes, \*Feedlots, Waste treatment, Waste disposal, Erosion control, Erosion, Water pollution control, Constitutional law, Administrative agencies, Agriculture, Federal government, Wastes, Water, Waste water disposal, Pollution abatement, Estuaries, Political constraints, Political aspects, Organic soils, Organic compounds.

Identifiers: Federal Water Pollution Control Act Amendments of 1972.

Agricultural pollutants reach water sources through point source discharges and through non-point agricultural runoff. Point source discharge of concentrated cattle feed lot wastes are highly visible and easily controlled. Consequently, the 1972 amendments to the Federal Water Pollution Control Act effectively regulate such discharges. Unfortunately, implementation of the 1972 amendments has not resulted in meaningful control of land runoffs or nonpoint sources of pollution, which are considered the greatest source of agricultural pollutants. One reason for the lack of effective regulatory measures is that elimination of nonpoint agricultural runoff would necessitate compulsory soil erosion practices. Instituting such measures would contravene widely held notions of the inviolability of private property. As a result, nonpoint sources will continue to be largely ignored while legislators debate the propriety of enforcement measures. (Joseph-Florida) W77-04347

#### LOUISIANA TIDELANDS PAST AND FUTURE, Louisiana Office of the Attorney General, Baton Rouge.

For primary bibliographic entry see Field 6E. W77-04350

#### THE COAST: WHERE ENERGY MEETS THE ENVIRONMENT,

San Diego Univ., Calif. School of Law.

For primary bibliographic entry see Field 6E. W77-04351

#### DEPARTMENT OF ECOLOGY,

Washington State Dept. of Ecology, Olympia.

For primary bibliographic entry see Field 6E. W77-04358

#### POLLUTION CONTROL HEARINGS BOARD SHORELINES HEARINGS BOARD COUNCIL ON ENVIRONMENTAL POLICY,

Washington State Pollution Control Hearing Board, Olympia.

For primary bibliographic entry see Field 6E. W77-04360

#### POWER PLANT SITING: CAUGHT BETWEEN ENERGY CRISIS AND ENVIRONMENTAL CONCERN,

Florida Univ., Gainesville. School of Law.

For primary bibliographic entry see Field 6E. W77-04363

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Quality Control—Group 5G

#### GARRISON DIVERSION UNIT IRRIGATION PROJECT: PROSPECTS AND PROBLEMS, PART 2.

For primary bibliographic entry see Field 6E.

W77-04365

Federal Register, Vol 41, No 93, p 19310-12, May 12, 1976 3 p, 3 tab.

Descriptors: \*Standards, Effluents, \*Water quality standards, \*Chemical wastes, \*Waste water treatment, Administrative agencies, Regulation, Chemical industry, Industrial wastes, Biochemical oxygen demand, Chemical oxygen demand, Pollutants, Economic impact, Water pollution, Federal government, Technology, Feasibility, Biological treatment, Activated carbon, Water quality control.

Identifiers: \*Administrative regulations, Butadiene, Butene.

The Environmental Protection Agency has amended the effluent limitations, guidelines, and standards for the manufacture of butadiene by the oxidative-dehydrogenation process. Several treatment systems capable of meeting the standards are described. For a process utilizing the best practicable control technology, effluent limitations are established for BOD<sub>5</sub>, TSS, and pH. Effluent limitations for a point source after application of the best available technology economically achievable and standards of performance for new sources include limitations on COD, BOD<sub>5</sub>, TSS, and pH. Pretreatment standards are specified for users of public treatment works. (Capehart-Florida)

W77-04368

#### BENZIDINE: PROPOSED TOXIC POLLUTANT EFFLUENT STANDARDS.

Environmental Protection Agency, Washington, D.C.

Federal Register, Vol 41, No 127, p 27012-17 June 30, 1976. 6 p.

Descriptors: \*Federal Water Pollution Control Act, \*Dyes, \*Toxicity, \*Water quality standards, \*Waste water treatment, Chemical industry, Industrial wastes, Navigable waters, Regulation, Standards, Federal government, Administrative agencies, Public health, Pollutants, Effluents, Textiles, Pulp and paper industry, Water pollution, Water pollution control.

Identifiers: \*Carcinogens, \*Benzidine, Administrative regulations.

Because of its carcinogenicity, the Environmental Protection Agency is proposing effluent standards for benzidine to be added to the proposed effluent standards for toxic pollutants. The proposed standards apply to benzidine-based dye manufacturers and manufacturers of paper goods, leather goods, and textile goods who use benzidine-based dyes in their processes. The regulation applies only to users and manufacturers who discharge wastes directly into navigable waters. Effluent standards are specified for both new and existing sources. A lengthy discussion of the proposed standards is included. Waste water treatment processes used by benzidine manufacturers and users are mentioned. (Capehart-Florida)

W77-04370

#### OCEAN DUMPING; PROPOSED REVISION OF REGULATIONS AND CRITERIA.

Environmental Protection Agency, Washington, D.C.

Federal Register, Vol 41, No 125, p 26644-67, June 28, 1976. 24 p.

Descriptors: \*Oceans, \*Waste disposal, \*Regulation, \*Permits, Administrative agencies, Federal government, Standards, Mercury, Toxicity, Sites, Disposal, Water pollution, Water pollution control, Water quality, Water pollution sources, Municipal wastes, Dredging, Legal aspects.

Identifiers: \*Ocean dumping, \*Ocean disposal, Administrative regulations.

The Environmental Protection Agency (EPA) is proposing revisions to the regulations governing

the transportation of wastes for ocean dumping. The procedures used by EPA to evaluate requests to dispose of dredged material in ocean waters in conjunction with a Corps of Engineers permit are clarified. A permit applicant will be required to show that alternatives to ocean dumping are either uneconomical or are more environmentally harmful. In general, permits will only be issued on an interim basis and will be valid for not more than one year. Criteria are proposed for the initial selections of disposal sites and for their management. Factors which must be considered in evaluating the impact of disposal and in determining the permissible levels of materials at a particular site are detailed. General permits are granted for the disposal of clean wrecks and hulls. (Capehart-Florida)

W77-04372

#### NAVIGABLE WATERS: DISCHARGE OF DREDGED OR FILL MATERIAL.

Environmental Protection Agency, Washington, D.C.

Federal Register, Vol 40, No 173, p 41292-98, September 5, 1975.

Descriptors: \*Permits, \*Dredging, \*Disposal, \*Landfills, \*Water pollution effects, Water pollution, Water pollution control, Water pollution sources, Water sources, Water supply, Shellfish, Fisheries, Sites, Wildlife, Recreation, Navigable waters, Administrative agencies, Federal government, Regulation, Environmental effects, Sediment discharge, Sedimentation, Silting.

Identifiers: \*Discharge permits, Administrative regulations.

The Environmental Protection Agency (EPA) in conjunction with the Army is establishing interim final guidelines for the evaluation of proposed discharge of dredged or fill material into navigable waters. The guidelines are to be applied to the issuance of permits for discharge at specified disposal sites. No discharge will be permitted which would have an adverse effect on municipal water supplies, shellfish beds and fishery areas, and wildlife or recreation areas. Procedures for evaluating proposed discharges are specified. The ecological impact resulting from discharge of dredged or fill material is to be assessed both as to the physical effects and as to the chemical-biological interactive effects. The functions performed by wetlands are listed to show the significant adverse impact that destruction of wetlands would have. In determining whether a permit should be granted, consideration shall be given to the need for the activity, the availability of alternate sites or methods of disposal, and the water quality standards. The EPA may identify in advance areas which are either suitable or unsuitable for possible future disposal sites. Such identification will be used in evaluating a permit application for the site. (Capehart-Florida)

W77-04373

#### MINERAL MINING AND PROCESSING POINT SOURCE CATEGORY: APPLICATION OF EFFLUENT LIMITATIONS GUIDELINES FOR EXISTING SOURCES FOR PRETREATMENT STANDARDS FOR INCOMPATIBLE POLLUTANTS.

Environmental Protection Agency, Washington, D.C.

Federal Register, Vol 40, No 201, p 48665-67, October 16, 1975. 3 p.

Descriptors: \*Mine water, \*Treatment facilities, \*Standards, \*Effluents, \*Federal Water Pollution Control Act, Mineralogy, Mining, Mine wastes, Water pollution, Water pollution sources, Water quality, Mineral industry, Waste water treatment, Pollutants, Regulation, Administrative agencies, Federal government.

Identifiers: Administrative regulations.

#### NAVIGABLE WATER OF THE STATE OF ARIZONA; WATER QUALITY STANDARDS.

Environmental Protection Agency, Washington, D.C.

Federal Register, Vol 41, No 121, p 25000-01, June 22, 1976. 2 p. 1 tab.

Descriptors: \*Federal Water Pollution Control Act, \*Arizona, \*Standards, \*Water quality control, \*Nutrients, \*Water quality standards, Federal government, State governments, Administrative agencies, Regulation, Colorado River, Salinity, Phosphates, Nitrates, Salts, Eutrophication, Control, Nutrient removal, Governmental interrelations, Rivers, Tributaries, River systems, Navigable waters.

Identifiers: \*Administrative regulations.

The Environmental Protection Agency (EPA) is establishing federal water quality standards for the state of Arizona as authorized by the Federal Water Pollution Control Act. Notice was given to the state that its standards did not conform with the requirements. Some of the state's revisions were satisfactory but since no quantitative nutrient criteria were established, the EPA was required to promulgate such standards. Criticisms of the EPA standards by Arizona state agencies and the EPA responses are included. Water quality standards are specified for salinity control in the Colorado River system. The mean annual total phosphate and nitrate concentrations allowable are given in tabular form. (Capehart-Florida)

W77-04366

#### OIL POLLUTION PREVENTION.

Environmental Protection Agency, Washington, D.C.

Federal Register, Vol 41, No 60, p 12657-8, March 26, 1976. 2 p.

Descriptors: \*Oil spills, \*Water pollution control, \*Water quality standards, \*Administrative agencies, Jurisdiction, Drilling, Offshore platforms, Federal government, Regulation, Facilities, Sites, Navigable waters, Dikes, Barriers, Controlled drainage, Structures, Underground storage, Project planning, Water pollution, Oil industry, Topography, Underground structures, Ships.

Identifiers: \*Administrative regulations.

For purposes of clarification, the Environmental Protection Agency is amending the regulations governing oil pollution prevention. The principal change is to clarify the criteria for determining whether a facility is subject to the regulations. Geographic location, such as proximity to navigable waters, is to be the sole determining factor. The presence of drainage control structures which might prevent a discharge from reaching navigable waters is not sufficient to exempt a facility. Facilities which might discharge oil in harmful quantities must prepare a Spill Prevention Control and Countermeasure (SPCC) plan in writing. Special procedures are specified for the implementation of SPCC plans for mobile or portable facilities such as onshore or offshore drilling rigs and portable fueling facilities. Such plans may be general and capable of implementation at each site; a new plan is not required each time a facility is moved. These regulations do not apply to vessels or transportation facilities subject to the control of the Department of Transportation. (Capehart-Florida)

W77-04367

#### BUTADIENE LIMITATIONS, GUIDELINES AND STANDARDS; AMENDMENT.

Environmental Protection Agency, Washington, D.C.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

The Environmental Protection Agency (EPA) has proposed regulations for the mineral mining and processing point source category which deal with the application of effluent limitations guidelines for existing sources to pretreatment standards for incompatible pollutants. The subcategories included in the regulations are gypsum, asphaltic minerals, asbestos and wollastonite, barite, fluor spar, salines from brine lakes, borax, potash, sodium sulfate, Frasch sulfur, bentonite, magnesite, diatomite, jade, novaculite, tripoli and graphite. The EPA has determined that the effluent limitations guidelines as established for existing sources shall not apply to pretreatment standards for incompatible pollutants at the present time. Since some process waste waters in these subcategories may interfere with the operation of a publicly owned treatment works or may pass through it untreated, the operator of such a treatment works should give these waters special consideration. (Capchart-Florida)  
W77-04374

**ENVIRONMENTAL PROTECTION AGENCY: GENERAL PERMITS FOR THE TRANSPORTATION FOR DUMPING, AND THE DUMPING OF MATERIAL INTO OCEAN WATERS.**  
Environmental Protection Agency, Washington, D.C.  
Federal Register, Vol. 40, No. 138, p. 30114-15, July 17, 1975.

Descriptors: \*Environmental control, \*Permits, \*Oceans, \*Organic wastes, Water law, Water pollution, Water pollution control, Water pollution effects, Water quality, Environment, Environmental effects, Legislation, Legal aspects, Federal government, Public rights, Regulation, Administration, Governments, Sea water, Ships.  
Identifiers: \*Marine protection, Research and Sanctuaries Act, \*Burial at sea.

Pursuant to Title 1 of the Marine Protection, Research, and Sanctuaries Act of 1972 (the Act), the Environmental Protection Agency (EPA) proposed general permits setting forth conditions under which burial at sea of human remains by persons subject to the Act, and the sinking at sea of target vessels by the United States Navy will be allowed. Section 229.1 authorizes the transport of human remains for burial at sea purposes along with burials complying with specified practices and requirements. Section 229.2 allows the United States Navy to transport vessels from the United States or other locations for purposes of sinking such vessels in ocean waters for testing ordinance. However, sinkings must occur at times determined by appropriate Navy officials. In addition, measures facilitating fast and permanent sinking must be employed and sinkings must occur at least 50 nautical miles from land in waters of at least 100 fathoms deep. (Hadoulias-Florida)  
W77-04375

**ENVIRONMENTAL PROTECTION AGENCY: PETROLEUM REFINING POINT SOURCE CATEGORY.**  
Environmental Protection Agency, Washington, D.C.  
Federal Register, Vol 40, No 98, p 21939-54, May 20, 1975. 16 p, 17 tab.

Descriptors: \*Effluents, \*Federal Water Pollution Control Act, \*Legislation, Standards, \*Federal government, Legal aspects, Legal review, Government, Administration, Regulation, Programs, Oil, Administrative decisions, Pollution control, Classification.  
Identifiers: \*Point source(Pollution).

The American Petroleum Institute filed petitions for review of regulations regarding effluent limitations, guidelines, and standards of performance and pretreatment standards applicable to topping subcategory, cracking subcategory, lube subcategory and integrated subcategory of the

petroleum refining category of point sources. Comments were received criticizing certain aspects of the regulations. A summary of the major comments and the Environmental Protection Agency's (EPA) responses are included within. After careful evaluation of these comments the EPA concluded that the size and process factors were too broad; therefore, a notice was published October 17, 1974, in the Federal Register of the EPA's intention to reduce the range sizes. A detailed discussion of the background of Sections 301 and 304 of the 1972 Amendments to the Federal Water Pollution Control Act (FWPCA) is included as well as a detailed discussion setting forth how the subcategories, flows, achievable concentrations and short term limits were derived beginning with the contractors report and ending with EPA's reconsideration. (Hadoulias-Florida)  
W77-04376

#### ENVIRONMENTAL PROTECTION AGENCY: INORGANIC CHEMICALS MANUFACTURING POINT SOURCE CATEGORY.

Environmental Protection Agency, Washington, D.C.  
Federal Register, Vol. 40, No. 100, p. 22424-45, May 22, 1975. 51 tab.

Descriptors: \*Effluents, Legislation, \*Chemicals, \*Federal Water Pollution Control Act, Federal government, Legal aspects, Legal review, Government, Laws, Administration, Regulation, Inorganic compounds, Programs, Standards, Classification.

Identifiers: Point source(Pollution).

The Administrator of the Environmental Protection Agency (EPA) has promulgated effluent limitation guidelines of performance and pretreatment standards for existing and new sources for the inorganic chemicals manufacturing point source category. The regulation herein proposed will amend 40 CFR Part 415 by adding additional point source categories. The federal regulations require effluent limitations for point sources other than publicly minded treatment works, and application of the best practicable control technology currently available as defined by regulations published by the Administrator. The regulations also require the Administrator to establish categories and pretreatment standards for new sources. Certain subcategories of the proposed regulation are incomplete due to EPA inability to obtain complete data within the deadline of the applicable court decree. The EPA intends to complete these subcategories at the earliest possible date. (Hadoulias-Florida)  
W77-04377

#### ASKEW V GAME AND FRESH WATER FISH COMMISSION (POLLUTION ABATEMENT EFFORTS HELD CONSTITUTIONAL).

For primary bibliographic entry see Field 6E.  
W77-04379

#### WATER RESERVOIRS.

For primary bibliographic entry see Field 6E.

W77-04381

#### OKLAHOMA PLANNING AND RESOURCES BOARD.

For primary bibliographic entry see Field 6E.  
W77-04382

#### PERMITS FOR USE OF PESTICIDES IN STATE WATERS.

For primary bibliographic entry see Field 6E.  
W77-04384

#### WATER QUALITY STANDARDS,

Environmental Protection Agency, Seattle, Wash.  
For primary bibliographic entry see Field 5C.  
W77-04436

**OIL CONSERVATION AND RECLAMATION,**  
APV Bowser Filtration, Ltd., Croydon (England).  
For primary bibliographic entry see Field 5D.  
W77-04455

**BASIN AGENCIES AND THE FIGHT AGAINST INDUSTRIAL POLLUTION (LES AGENCES DE BASSIN ET LA LUTTE CONTRE LA POLLUTION INDUSTRIELLE),**  
For primary bibliographic entry see Field 5D.  
W77-04457

**THE PRESENT AND FUTURE OF COASTS.**  
Coastal Society, Bethesda, Md.  
For primary bibliographic entry see Field 2L.  
W77-04462

**EXPLORATION AND PETROLEUM DEVELOPMENT OF THE U.S. OUTER CONTINENTAL SHELF: A MOVE TOWARD SELF-SUFFICIENCY,**  
For primary bibliographic entry see Field 6G.  
W77-04468

**FLORIDA'S EXPERIENCE - THE WAY WE WERE - AND SHOULDN'T HAVE BEEN,**  
Florida Audubon Society, Maitland.  
H. Scott.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p 68-76.

Descriptors: \*Resources development, \*Leases, \*Oil, \*Natural gas, \*Environmental effects, \*Florida, Coasts, Water quality control, Economics.

Identifiers: \*Outer Continental Shelf, \*Coastal zone management, Offshore exploration, Petroleum resources, Environmental protection.

Proper development of the nation's petroleum resources depends upon a realistic appraisal of all the costs and benefits anticipated to result from Outer Continental Shelf activities and the preparation of plans to deal effectively with negative impacts before they occur. State involvement in the entire process is essential. The states have had no direct input into either leasing schedules or environmental studies schedules. Therefore, we feel that the studies necessary to make considered decisions are the responsibility of the federal agency which has imposed these time constraints upon us. We request that the Department of the Interior take appropriate action to have baseline study results considered in leasing decisions. We further request that the Department of the Interior assure opportunities and funding to design and conduct research on onshore and nearshore impacts. Only through these actions will the states of the Department have the information needed to make rational decisions and inputs to the leasing decision-making process. (See also W77-04462) (Sinha-OEIS)  
W77-04469

**ECOBALIUM, A BALANCE BETWEEN ECONOMY AND ECOLOGY,**  
National Oceanic and Atmospheric Administration, Washington, D.C. Office of the Administrator.

For primary bibliographic entry see Field 6G.  
W77-04470

**BEACH FILL PLANNING - BRUNSWICK COUNTY, NORTH CAROLINA,**  
Army Engineer District, Wilmington, Del. Coastal Engineering Studies Section.  
For primary bibliographic entry see Field 2L.  
W77-04471

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Quality Control—Group 5G

**COASTAL ENVIRONMENTAL IMPACT ASSESSMENT: LESSONS FROM OIL SPILLS,**  
University of Southern California, Los Angeles.  
Allan Hancock Foundation.  
For primary bibliographic entry see Field 6G.  
W77-04472

**FARMERS AND FISHERMEN: INTERACTION IN THE COASTAL ZONE,**  
Maryland Univ., College Park. Cooperative Extension Service.  
For primary bibliographic entry see Field 6G.  
W77-04473

**PEOPLE AND THE SEA: FUTURE IMPACTS AND OPPORTUNITIES,**  
Delaware Univ., Lewes. Coll. of Marine Studies; and Delaware Univ., Newark. Marine Studies Complex.  
For primary bibliographic entry see Field 6G.  
W77-04474

**THERMAL POLLUTION IN THE LOS ANGELES-LONG BEACH HARBOR: CONSEQUENCES AND ALTERNATIVES,**  
University of Southern California, Los Angeles.  
Allan Hancock Foundation.  
For primary bibliographic entry see Field 5B.  
W77-04476

**THE WETLANDS DILEMMA: A SOLUTION,**  
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.  
For primary bibliographic entry see Field 6G.  
W77-04477

**FOCUSING ON VISUAL QUALITY OF THE COASTAL ZONE,**  
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.  
For primary bibliographic entry see Field 6B.  
W77-04481

**ONSHORE POLICY RESEARCH AND OFFSHORE OIL: A BRITISH PERSPECTIVE,**  
Cook Coll., New Brunswick, N. J. Environmental Resources.  
For primary bibliographic entry see Field 6G.  
W77-04484

**COMMENTS ON FOOD AND ENERGY RESOURCES IN THE COASTAL ZONE,**  
Federal Power Commission, Washington, D.C.  
Office of Energy Systems.  
For primary bibliographic entry see Field 2L.  
W77-04487

**ADJACENT STATES' RESPONSIBILITIES IN OUTER CONTINENTAL SHELF ACTIVITIES,**  
Virginia Energy Office, Richmond.  
E. Wilson.  
In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 275-278.

Descriptors: Water resources, \*Oil industry, \*Natural gas, \*Water pollution control, \*Resources development, \*Pollution abatement, Coasts, Territorial waters, Federal Government, Leases, State government, Local government, Regulations.  
Identifiers: \*Outer Continental Shelf, \*Energy sources, Adjacent states, Offshore technology.

The states' responsibilities have developed into a broad supporting role for the development of offshore energy resources, under the broad top management of the Federal Government. The

states' activities must include the full spectrum of support, including management of the industrial-development aspects of the resources after they have been brought ashore. To enable the states to properly discharge their supporting and ancillary role, the Federal Government must give the states voice in the activities and must give them the necessary funding and flexibility to get the job done in the best possible way. If everybody works together, we can become energy-self-sufficient. Further, this can be done in a way as to enhance and develop our coastal areas, improve rather than degrade the social systems and life styles of these delicate ecosystems and, of equal importance, the coastal states will be able to fully discharge their responsibilities to their own people, from the marine-oriented activities to include all levels of community, social and industrial activity. These are the OCS responsibilities of the coastal states. (See also W77-04462) (Sinha-OEIS)  
W77-04489

**A RISK AND COST ANALYSIS OF TRANSPORTING SOUTHERN CALIFORNIA OUTER CONTINENTAL SHELF OIL,**  
Booz-Allen and Hamilton Inc., Bethesda, Md.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 738, Price codes: A06 in paper copy, A01 in microfiche. Report to U.S. Environmental Protection Agency, Report No. 9075-029-001, July 1975. 61 p, 17 fig, 13 tab, 3 append.

Descriptors: \*Continental Shelf, \*Oil spills, \*Oil pollution, \*Water pollution sources, \*Pipelines, \*Cost analysis, \*Risks, Transportation, Resources development, Environmental effects, California.  
Identifiers: \*Outer Continental Shelf, \*Tankers, U.S. West Coast.

The risk of oil spills and the costs associated with alternative modes of transporting oil from proposed new Outer Continental Shelf (OCS) lease areas to onshore facilities in Southern California is evaluated. The objective is to assess oil transport risks and costs for specific hypothetical production sites in a formal, analytical fashion to provide policymakers with a clearer picture of appropriate development options. (Sinha-OEIS)  
W77-04490

**ECOLOGICAL MODELING IN A RESOURCE MANAGEMENT FRAMEWORK,**  
Resources for the Future, Inc., Washington, D.C.  
For primary bibliographic entry see Field 6G.  
W77-04493

**ECOLOGICAL MODELING IN A RESOURCE MANAGEMENT FRAMEWORK: AN INTRODUCTION,**  
Resources For the Future, Inc., Washington, D.C.  
Quality of the Environment Program.  
For primary bibliographic entry see Field 6G.  
W77-04494

**A DISCUSSION OF CLEAN, THE AQUATIC MODEL OF THE EASTERN DECIDUOUS FOREST BIOME,**  
Tetra Tech, Inc., Lafayette, Calif.  
For primary bibliographic entry see Field 6G.  
W77-04496

**THE DELAWARE ESTUARY,**  
Resources for the Future, Inc., Washington, D.C.  
For primary bibliographic entry see Field 6G.  
W77-04497

**APPLICATION OF MATHEMATICAL MODELS TO THE STUDY, MONITORING AND MANAGEMENT OF THE NORTH SEA,**  
Liege Univ. (Belgium).  
For primary bibliographic entry see Field 6G.  
W77-04498

**EVALUATION OF WATER QUALITY MODELS: A MANAGEMENT GUIDE FOR PLANNERS,**  
Systems Control, Inc., Palo Alto, Calif.

G. P. Grimsrud, E. J. Finnemore, and H. J. Owen. Available from the National Technical Information Service, Springfield, VA 22161 as PB-256 412, Price codes: A09 in paper copy, A01 in microfiche. Report EPA-600/5-76-004, Socioeconomic Environmental Studies Series, U.S. Environmental Protection Agency, Washington, D.C., July 1976. 176 p, 5 fig, 25 tab, 48 ref.

Descriptors: \*Water quality, \*Model studies, \*Planning, \*Management, \*Evaluation, Decision making, Costs, Estimating, Systems analysis, Waste water(Pollution), Simulation analysis, Performance.

Identifiers: Cost effectiveness, Index rating, Contracting, Assimilation analysis, Wasteload allocation.

This report is designed as a handbook for water quality and water resources planners and managers. It presents a large amount of basic information concerning water quality modeling, including procedures for model evaluation, model selection, integration of modeling with planning activities, and contracting modeling projects. For planners without previous experience in water quality modeling, the information and procedures help to determine whether a water quality model could and should be used in a particular planning program, and which specific model would be cost effective. This includes a step-by-step procedure leading to the rejection or selection of models according to specific project needs. Discussed are the implications which accompany the decision to model, including the needs for additional labor and specialized technical expertise which are generated. Methods and procedures for integrating the use and results of water quality models with other activities of the planning process are described as well as the respective merits of in-house and contracted modeling. Also considered are procedures for obtaining and using contractual services for water quality modeling. Instructions are provided for the preparation of solicitations, evaluation of proposals, and selection of contractors. (Bell-Cornell)  
W77-04507

**HOW SHOULD INDUSTRY VIEW POLLUTION CHARGES,**  
R. R. Martindale.  
CBI Review, Summer 1976, p. 11-20.

Descriptors: \*Pollution taxes(Charges), \*Water pollution control, Feasibility, Evaluation, Effluents, Industrial wastes, Industries.  
Identifiers: \*United Kingdom.

The pros and cons of the use of a system of pollution charges or taxes to control discharges into rivers and tidal waters in the United Kingdom are examined. In comparison with the present system of discharge regulations, a pollution tax system was found to have major disadvantage: (1) the need to impose different charges on different discharges in different situations and for different pollutants, (2) the uncertainty of the level of pollution abatement which would be achieved at any level of charge, (3) an insensitivity to individual company problems, and (4) additional administrative expense. Four advantages of a pollution tax system are also cited: (1) total costs of the resultant environmental improvement will be reduced by a better cost allocation between dischargers, (2) an incentive for dischargers to find the cheapest way to reduce their pollution is provided, (3) an automatic and more consistent method of control is provided which operates without the inconsistencies of outside interference, and (4) efficiency of operation. It is concluded that the disadvantage outweigh the advantages, and that it is most unlikely that the pollution taxes system will be substituted for the regulation system, through it

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could be used to supplement the regulation system. (Luedtke Wisconsin). W77-04557

#### THE LIMITS OF COST-BENEFIT ANALYSIS AS A GUIDE TO ENVIRONMENTAL POLICY, Leicester Univ. (England).

D. Pearce.

Kyklas, Vol. 29, No. 1, p. 97-112, 1976. 4 fig., 9

Descriptors: \*Waste assimilative capacity, \*Cost-benefit analysis, \*Environmental control, \*Decision making, Water pollution sources, Waste disposal, Ultimate disposal, Degradation (Decomposition), Economics, Evaluation, Pollutants, Environmental effects, Public health. Identifiers: \*Environmental assimilative capacity.

It is shown that cost-benefit analysis has only limited relevance to situations in which the effective assimilative capacity of the environment is zero and the pollutants in question have biological effects. This is the case for accumulating pollutants. In the case of conventional pollutants that have ecological effects, it is shown that conventional externality correction will not prevent a dynamic process of increasing ecological instability. The optimal solution is therefore one that requires output levels below those initially dictated by cost-benefit criteria. It is shown that the ecological optimum is also a long-run welfare maximum that is unlikely to coincide with the optimum derived by ordinary cost-benefit analysis. To define the cost-benefit limitations, the study classifies pollutants with respect to their biological and economic characteristics, permitting the derivation of a taxonomy of pollution. In order to analyze the taxonomy, a 'pollution tree' is sketched in which comparisons are made of the waste residual characteristics, economic effects and biological effects of various classes of pollutants. The conventional cost-benefit approach is briefly outlined, and it is shown that this approach has direct relevance only to those pollutants that have obvious nuisance features and which do not have sustained ecological effects. (Harris-Wisconsin)

W77-04561

#### THE EFFICIENCY OF TAXES AND SUBSIDIES IN REDUCING EMISSION BY A RISK-AVERSE FIRM, New York Univ., N.Y. Graduate School of Business Administration.

Y. Amitud.

Kyklas, Vol. 29, No. 1, p. 113-117, 1976. 8 ref.

Descriptors: \*Pollution abatement, \*Pollution taxes (Charges), \*Government finance, Market value, Economics, Taxes, Regulation, Risks, Profit.

Identifiers: \*Pollution abatement subsidies, Effluent charges.

Subsidies are seen as an inefficient means of regulating pollution emissions in an examination of comparative effects of two alternative policies aimed at impelling firms to reduce their polluting emissions: a tax per unit of emission or a subsidy per unit withheld. In companies faced with uncertainty whose decision makers are risk-averse, short-run production decisions depend on the total firm profit, rather than only the marginal profit, regardless of the firm's ownership form. Moreover: (1) the subsidy is always less efficient than an equal-rate tax in curbing emission; (2) in some extreme cases, a subsidy may even cause the firm to increase rather than decrease its emission; and (3) the effect of the subsidy is inversely related to the magnitude of the value of the level of emission which serves as a base for the subsidy payments. The larger the quantity of the firm's emission output, the less efficient the subsidy will be, regardless of its per-unit magnitude. One of the major problems in developing such subsidies is the

need to assess the quantity of the firm's output of emissions, because the polluter may find it profitable to increase the level of emissions in order to make the assessed base larger. (Harris-Wisconsin) W77-04564

#### EFFECT OF WATER QUALITY AND IRRIGATION FREQUENCY ON FARM INCOME IN THE IMPERIAL VALLEY, California Univ., Davis. Dept. of Agricultural Economics.

For primary bibliographic entry see Field 3C.

W77-04566

#### ENFORCEMENT UNDER THE ILLINOIS POLLUTION LAW, Chicago Univ. Law School, Ill.

D. P. Currie.

Northwestern Univ. Law Review, Vol. 70, No. 3, p. 389-485, 1976.

Descriptors: \*Legislation, \*Illinois, \*Water pollution control, \*Pollution abatement, Legal aspects, Legal review, Judicial decisions, Water law, Permits, Zoning, Political constraints, Laws, Regulation, Law enforcement.

Identifiers: \*Illinois Environmental Protection Act (1970).

A legal review finds that Illinois' 1970 Environmental Protection Act, a sweeping revision of the state's pollution control program, worked reasonably well during its first few years of post-enactment despite numerous deficiencies in drafting due to time limitations, insufficient foresight and the necessity for compromise. The performance of the Illinois Pollution Control Board is seen as reflecting occasional instances of excessive zeal, and judicial review has been uneven-sometimes interfering excessively with the Board's exercise of judgement and at other times deferring too uncritically. Detailed descriptions are given of the substantive and procedural problems presented by the three formal methods of applying the law and regulations: complaint, variance, and permit. Relative to the substantive law, discussion is made of territorial scope; legal definitions of terms; descriptions of strict and vicarious liability; compliance costs and related considerations; variance standards; penalty policies; unreasonable interference; sanctions; and special problems of municipal sources. A description of the machinery of enforcement includes a review of the organization of the Pollution Control Agency and Board; prosecution and hearing procedures; settlements; burden of proof and related problems; variances and permits; private and public information; and judicial review. (Harris-Wisconsin)

W77-04567

#### AQUATIC PLANTS: A GUIDE FOR THEIR IDENTIFICATION AND CONTROL IN PENNSYLVANIA, Pennsylvania Water Resources Coordinating Committee, Harrisburg.

E. R. Brezina, W. J. Harmon, A. D. Bradford, and R. B. Hesser. 1971. 63 p. 15 fig., 3 tab. \$1.50.

Descriptors: \*Aquatic plants, \*Algae, \*Pennsylvania, \*Aquatic weed control, Varieties, Herbicides, Rates of application, Permits, Application methods, Mechanical control, Chemcontrol, Biocontrol, Publications.

A field manual provides guidelines for proper methods to control nuisance aquatic vegetation. Algae, free floating, submergent, and emergent plants are illustrated and described and specific herbicides are suggested, together with applicable concentrations and dosage. Mechanical control methods, such as physical removal, dredging of a water body to increase depth, other alternatives, and the potential of biological controls are also

discussed. Precise instructions are given for time of treatment, methods of application, calculations for determining the area to be treated and calculations for determining dosage. Also included are laws and regulations applicable to the use of herbicides in Pennsylvania, to other pollutants as they affect downstream users and fish, and a description of the permit system. A chemical dosage chart and conversion tables are provided. (Auer-Wisconsin) W77-04570

#### RESPONSE OF AEROBIC COMMUNITY METABOLISM TO CHEMICAL TREATMENT OF AQUATIC MACROPHYTES, Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.

For primary bibliographic entry see Field 5C.

W77-04576

#### BACTERIAL DEGRADATION OF MOTOR OIL, Maryland Univ., College Park. Dept. of Microbiology.

For primary bibliographic entry see Field 5B.

W77-04577

#### STUDIES ON THE JAPANESE CHIRONIMID MIDGE AS A NUISANCE: I. LARVICIDAL EFFECTS OF SOME ORGANOPHOSPHORUS INSECTICIDES AGAINST THE LAST LARVAE OF CHIRONOMUS YOSHIMATSU MARTIN AND SUBLETTE, (IN JAPANESE), National Inst. of Health, Tokyo (Japan). Dept. of Medical Entomology.

For primary bibliographic entry see Field 5C.

W77-04592

#### NEGATIVE EFFECTS OF PHOSPHATE IN SURFACE WATERS, (IN GERMAN), For primary bibliographic entry see Field 5C.

W77-04593

#### STUDY ON HYGIENIC STANDARDIZATION OF N-BUTYLAMINES IN WATER BODIES, (IN RUSSIAN), Leningradskii Meditsinskii Institut (I) (USSR). Dept. of Public Hygiene. E. I. Trubko.

Gig Sanit 11, p 21-23, 1975.

Descriptors: \*Organic compounds, Public health, \*Water quality standards, \*Organoleptic properties.

Identifiers: \*Butylamines.

The effect of N-butylamines on the organoleptic properties of water and the sanitary regimen of water bodies and their toxic action on warm-blooded animals were studied. (LD50's were determined for mice, rats and guinea pigs.) All the indices studied had very close threshold values. The suggested maximal permissible concentrations are 8 mg/l for monobutylamine and 6 mg/l for dibutylamine, judging by the toxicologic index of noxiousness.—Copyright 1976, Biological Abstracts, Inc.

W77-04597

#### PROGNOSIS OF PESTICIDE STABILITY IN WATER, SOIL AND PLANTS, (IN RUSSIAN), Kievskii Meditsinskii Institut (USSR).

For primary bibliographic entry see Field 5B.

W77-04600

## WATER RESOURCES PLANNING—Field 6

### Techniques Of Planning—Group 6A

#### 6. WATER RESOURCES PLANNING

##### 6A. Techniques Of Planning

**ROLE OF THE HEAT STORAGE WELL IN FUTURE U.S. ENERGY SYSTEMS,**  
General Electric TEMPO, Santa Barbara, California, Center for Advanced Studies.  
For primary bibliographic entry see Field 4B.  
W77-04145

**LIMNOLOGICAL ECOSYSTEMS AND HAWAII'S PRESERVATIONAL PLANNING,**  
J. A. Maciolek.  
Verhandlungen Internationale Vereinigung Limnologie, Vol. 19, Part II, p. 1461-1467, 1975. 4 figs, 9 ref.

Descriptors: \*Planning, \*Conservation, \*Comprehensive planning, Water management(Applied), \*Hawaii, Lentic environment, Lotic environment, Freshwater, Lakes, Streams, \*Natural resources, Water resources development, State governments, Ecosystems, Limnology, Eutrophication.

A brief but comprehensive inventory of Hawaii's natural inland limnological resources is presented, providing a basis for comparison of aquatic resource status with other oceanic islands. The information was extracted from results of a preliminary statewide survey—part of a comprehensive planning program in which available resource information and field investigations were utilized to locate and designate remaining areas of high natural quality. The survey resulted in a list of 70 potential reserve sites, 23 of them with significant limnological components. The sites range in size from 4 to 5,600 ha in area and contain intact drainage systems as well as single small pools harboring unique species. Compact descriptions are given of the state's lentic and lenitic waters. Among the former, nine candidate reserve areas contain stream elements as qualifying features. Three of the areas include two drainages so that a total of 12 stream ecosystems are being considered for preservation. Only four intact, pristine drainage basins of consequence remain in the state and all four are candidate reserve areas. In the case of the lenitic waters, montane pools are a distinct aquatic feature, but few real lakes occur in Hawaii because lithology and edaphic factors are not conducive to basin sealing. Most of the state's lowland pools have been severely degraded. (Harris-Wisconsin)  
W77-04149

**POLLUTION ABATEMENT AND REGIONAL WELFARE: A CONTROL THEORY APPROACH,**  
State Univ. of New York at Binghamton.  
For primary bibliographic entry see Field 6G.  
W77-04169

**A DYNAMIC BALANCED REGIONAL INPUT-OUTPUT MODEL OF POLLUTION CONTROL,**  
State Univ. of New York at Binghamton. School of Management.  
For primary bibliographic entry see Field 5G.  
W77-04209

**COASTAL-ZONE PLANNING: AN INTEGRATED APPROACH,**  
Nassau-Suffolk Regional Planning Board, N.Y.  
For primary bibliographic entry see Field 2L.  
W77-04464

**ECOLOGICAL MODELING IN A RESOURCE MANAGEMENT FRAMEWORK,**  
Resources for the Future, Inc., Washington, D.C.

For primary bibliographic entry see Field 6G.  
W77-04493

#### ECOLOGICAL MODELING IN A RESOURCE MANAGEMENT FRAMEWORK: AN INTRODUCTION,

Resources For the Future, Inc., Washington, D.C. Quality of the Environment Program.  
For primary bibliographic entry see Field 6G.  
W77-04494

**CLEANER: THE LAKE GEORGE MODEL,**  
Rensselaer Polytechnic Inst., Troy, N.Y. Fresh Water Inst.  
For primary bibliographic entry see Field 6G.  
W77-04495

#### A DISCUSSION OF CLEAN, THE AQUATIC MODEL OF THE EASTERN DECIDUOUS FOREST BIOME,

Tetra Tech, Inc., Lafayette, Calif.  
For primary bibliographic entry see Field 6G.  
W77-04496

**THE DELAWARE ESTUARY,**  
Resources for the Future, Inc., Washington, D.C.  
For primary bibliographic entry see Field 6G.  
W77-04497

#### APPLICATION OF MATHEMATICAL MODELS TO THE STUDY, MONITORING AND MANAGEMENT OF THE NORTH SEA,

Liege Univ. (Belgium).

For primary bibliographic entry see Field 6G.  
W77-04498

#### PHYTOPLANKTON MODELS AND EUTROPHICATION PROBLEMS,

Manhattan Coll., Bronx, N.Y. Environmental Engineering and Science Program.  
For primary bibliographic entry see Field 5C.  
W77-04499

#### FISH POPULATION MODELS: POTENTIAL AND ACTUAL LINKS TO ECOLOGICAL MODELS,

National Marine Fisheries Service, Beaufort, N.C. Atlantic Estuarine Fisheries Center.  
For primary bibliographic entry see Field 6G.  
W77-04500

#### FISHERIES AND ECOLOGICAL MODELS IN FISHERIES RESOURCE MANAGEMENT,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.  
For primary bibliographic entry see Field 6G.  
W77-04501

#### MANAGEMENT OF LARGE-SCALE ENVIRONMENTAL MODELING PROJECTS,

Oak Ridge National Labs., Tenn.  
For primary bibliographic entry see Field 6G.  
W77-04502

#### PRESENT PROBLEMS AND FUTURE PROSPECTS OF ECOLOGICAL MODELING,

Resource Management Associates, Lafayette, Calif.  
For primary bibliographic entry see Field 6G.  
W77-04503

#### GAME THEORY APPROACH TO DESIGN UNDER UNCERTAINTY,

Brookhaven National Lab., Upton, N.Y.  
For primary bibliographic entry see Field 5D.  
W77-04504

**RESERVOIR YIELD USING TPM METHOD,**  
Ministry of Water Development, Salisbury (Rhodesia).  
For primary bibliographic entry see Field 3B.  
W77-04505

**INTRODUCTORY REMARKS ON THE STATE SPACE MODELING OF WATER RESOURCE SYSTEMS,**  
International Inst. for Applied Systems Analysis, Laxenburg (Austria).  
A. Szollosi-Nagy.  
Research Memorandum, RM-76-73, October 1976. 81 p, 13 fig, 55 ref.

Descriptors: \*Water resources, \*Systems analysis, \*Equations, \*Model studies, Hydrology, Water storage, Reservoirs, Rainfall, Runoff, Water quality control, Simulation analysis, Input-output analysis, Stochastic processes.

Identifiers: Continuous systems, Discrete systems, Linear systems, State space models, Transition matrix, Gaussian noise processes.

In the day-to-day management of river basins, one of the crucial issues is the derivation of real-time operating policies, which are to be optimal for the water resource system. As telemetered systems are gradually coming into use, this problem is becoming more important for decision makers. There is much room for methodological research, in view of the random nature of water resource systems. Therefore, the IIASA Research Plan for 1976 provides a task on the Methodology of Real-Time Forecasting and Control of Water Resource Systems. Herein, an insight is given into the applicability of modern systems theory to water resource systems. The notion of state and state equations is discussed both for continuous and discrete dynamics. Presented is the solution of state equation for linear systems including the derivation of state transition and impulse response matrices. The structural properties such as observability, controllability, identifiability and minimal realizations are discussed. Finally, the state concept for stochastic systems is reexamined. The state and measurement disturbances are considered as being white Gaussian noise processes and it is shown how the case of sequentially correlated uncertainties can be reduced to an augmented system model having white Gaussian state disturbance only. The paper concludes with the generalization of structural properties for stochastic systems. To illustrate the underlying concepts, example problems concerning rainfall analysis, rainfall/runoff relation, reservoirs and lake/aquifers, water quality control, etc., are presented. (Bell-Cornell)

W77-04506

#### EVALUATION OF WATER QUALITY MODELS: A MANAGEMENT GUIDE FOR PLANNERS,

Systems Control, Inc., Palo Alto, Calif.  
For primary bibliographic entry see Field 5G.  
W77-04507

#### MATHEMATICAL MODELS,

Princeton Univ., N.J.

R. Cleary.

In: *Boundaries of Analysis: An Inquiry into the Tocks Island Dam Controversy*, Harold A. Feiveson, Frank W. Sinden, and Robert H. Socolow, Eds., p 295-315 (Chapter 8), Ballinger Publishing Company, Cambridge, Mass., 1976. 3 fig, 18 ref.

Descriptors: \*Mathematical models, \*Decision making, \*Water quality, \*Simulation analysis, \*Ecosystems, \*Water resources, Computer models, Stochastic processes, Time, Temperature, Dams, Reservoirs, Hydrodynamics, Dissolved oxygen, Eutrophication, Systems analysis.

Identifiers: \*Tocks Island Dam(Penna), Transport dynamics, Deterministic models.

## Field 6—WATER RESOURCES PLANNING

### Group 6A—Techniques Of Planning

Mathematical modeling in water resources decision making has become such an esoteric and guarded art that only a small number of people are qualified to interpret the results and inner workings of current models; an even smaller group is able to develop models. This essay discusses mathematical modeling and the role of simulation in terms understandable to the decision maker and the concerned layman. The Tocks Island Dam controversy is used as an illustrative example of the current use of modeling for water resources decision making. The role of a currently popular ecosystem computer simulation model, LAKECO, in this controversy is considered; its examination serves as an informative case history of the application of a major digital computer simulation model. Water resources modeling is discussed in terms of its evolution, models in general, deterministic versus stochastic models, modeling variables and transport dynamics, and space and time. Next, mathematical models and the decision maker are considered. Finally, the Tocks Island eutrophication problem is discussed, touching upon the McCormick Report and describing LAKECO in detail. Highlighted is the hydrodynamic simulation in LAKECO. LAKECO allows extension of early ecosystem modeling efforts to deep water bodies where vertical concentration variations may be modeled by a series of stacked stirred tanks. In the case of Tocks Island, however, the application of LAKECO has not resulted in a clarification of the eutrophication issue. The model's strengths and weaknesses are considered. (Bell-Cornell)

W77-04523

### 6B. Evaluation Process

#### PUBLIC INFORMATION ON WATER RESOURCES IN THE LAKE ERIE TRIBUTARY BASIN OF NORTHERN OHIO: CONTENT AND EXPOSURE,

Ohio State Univ., Columbus. School of Journalism.

G. R. Rarick.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 288, Price codes: A06 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus, Project Completion Report 446X, July 1976. 113 p, 40 tab, append. OWRT-A-034-OHIO(1).

Descriptors: \*Lake Erie, \*Water utilization, \*Communications, \*Attitudes, Recreation, \*Ohio, Social aspects, Water supply, Surveys, \*Lake basins.

Identifiers: \*Newspapers, \*Television, \*Radio, \*Public information, \*Content analysis, Government publications, Vacations, Voter registration, Information sources.

This study is in two parts: A survey, by self-administered questionnaire, of 456 adult residents of the Lake Erie Tributary Basin of Northern Ohio, and a content analysis of samples of daily newspapers, radio newscasts, and television newscasts. The survey revealed that swimming was the most popular water recreation activity, with fishing, boating, and picnicking at lakes and rivers also popular. Most such recreation took place on weekends in summer. Young respondents and households with children were the most likely to engage in water recreation in general, but fishing was popular with all ages. Households with an annual income of under \$5,000 were by far the least likely to engage in water recreation. A huge majority of respondents said water pollution was a problem in Northern Ohio. Other people were named most often as being important sources of water recreation information, with newspapers a close second. Newspapers were the most important source of non-recreation water information. The content analysis showed that newspapers gave 2.3% of their 'newsholes' to water information. About 3.1% of television's news time was given to water items, as was 4% of radio news

time. However, newspapers contained more information, averaging an estimated 980 words of water information per paper per day, compared to 50 words per TV station per day and 45 words per radio station per day. Newspapers tended to publish 'good news' about water resources, radio emphasized neutral and 'bad news' and television covered mostly 'bad news.' The media concentrated coverage on events rather than conditions. W77-04101

#### NEW MEXICO WATER RESOURCES, ASSESSMENT FOR PLANNING PURPOSES.

Bureau of Reclamation, Amarillo, Tex. S Region 5.

November 1976. 218 p, 31 fig, 48 tab, 30 ref. Prepared by Bureau of Reclamation in Cooperation with the New Mexico Interstate Stream Commission and the State Engineer Office.

Descriptors: \*Water resources development, \*New Mexico, \*Water requirements, Surveys, \*Future planning(Projected), River basins, \*Water supply, Human population, Legal aspects, Water law, Water quality, \*Water utilization, Management, \*Projections, Water conservation, \*Evaluation.

This report, with the accompanying portfolio of 23 maps, presents an appraisal-level study of the present and future water requirements of the State of New Mexico. It contains an adequate inventory of the State's water resources but presents no actual plan of development. The data are presented by basins for each of the six major river basins in the State. Future water requirements are based on three levels of population growth and economic development. The water requirements are estimated for the 1980, 2000, 2020 population levels; it is likely that all of these levels will be attained. Topical discussions are presented on the most serious water problems. Historical population data are presented and the three population projections used in the studies are discussed. A general discussion of the basic water laws includes water rights, compacts, adjudications, and treaties. The quantity and quality of the water supplies available to New Mexico are discussed; the quality discussion is limited to sediment and chemical quality. Estimates of present water uses and future requirements are projected. Withdrawals or diversion requirements are given in most instances, but future water requirements are based on depletions. The projected water requirements are based on satisfying the demands arising from each of the three population projections. An analysis is presented of the future water utilization and management possibilities to permit New Mexico to best meet its projected needs from available interstate water supplies. The principal means considered is the diversion of water from irrigation use, presently accounting for 90 percent of all water used, to supplying urban areas, refining minerals, manufacturing, and producing electrical power. Potential water saving methods and highly technical possibilities of getting more water are also analyzed, including weather modification and reservoir evaporation suppression. (Bur of Rec)

W77-04112

#### ISSUES AND OPINIONS ON THE SOCIAL EFFECTS OF WATER ALLOCATION FOR COAL DEVELOPMENT IN THE YELLOWSTONE RIVER DRAINAGE,

Montana State Univ., Bozeman.

L. G. Faulkner.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 484, Price codes: A09 in paper copy, A01 in microfiche. Montana University Joint Water Resources Research Center, Bozeman, Report No. 78, July 1976. 178 p, 1 fig, 27 tab, 48 ref, 3 append. OWRT-C-6303 (No. 5230)(1).

Descriptors: Social aspects, \*Social values, Industrial water, Irrigation water, Recreation, \*Water

utilization, Wyoming, \*Attitudes, \*Water allocation(Policy), \*Water policy, Strip mines, Coal mines, Mining.

Identifiers: \*Yellowstone River, \*Coal development, Public opinion.

The results of this study define issues of major concern to decision makers, water users, and residents of the Yellowstone River drainage. Issues revolve around the possible effects of allocation of water from the study area to the coal development industry. Water use issues include potential impacts on water quality, in-stream flow, water quality, and groundwater, water needs of reclamation, major water development and water rights. Social issues include rapid population growth, lifestyle changes, economic impacts, impacts on the Indian reservations, loss of local control and increases in crime. Policy questions explored in the study included attitudes toward present handling of coal development issues and information by state and local authorities, levels of coal development, and alternate means of shipping coal. Residents felt most of the political power to direct coal development was in the hands of federal government or industry, with state governments seen as third most powerful. Implications for policy were drawn from the results of the residents' survey and were further presented to people in the study area by way of forums held in several towns within the region. Forum respondents validated the survey results and suggested refinements to these policy implications. These refined implications are listed in the conclusions. (Stuart-Montana State)

W77-04146

#### LIMNOLOGICAL ECOSYSTEMS AND HAWAII'S PRESERVATIONAL PLANNING,

For primary bibliographic entry see Field 6A.

W77-04149

#### THE LAKE TAHOE STUDY...AS REQUESTED BY THE 92ND CONGRESS IN SECTION 114 OF THE FEDERAL WATER POLLUTION CONTROL ACT OF 1972.

Environmental Protection Agency, San Francisco, Calif. Surveillance and Analysis Div.

For primary bibliographic entry see Field 5G.

W77-04168

#### ANALYZING THE MARGINAL COST OF WATER SUPPLY,

International Labour Office, Geneva (Switzerland).

R. Turvey.

Land Economics, Vol. 52, No. 2, p. 156-168, 1976. 3 tab, 1 ref.

Descriptors: \*Marginal costs, \*Water supply, Economics, Costs, Average costs, Pricing, Water distribution(Applied), Water allocation(Policy), Project planning.

Identifiers: \*Water distribution costs.

The concept of the marginal costs of supplying water—a concept clearly differentiated from accounting costs—is described in general terms, using illustrative examples. Marginal cost is described as the effect upon future system costs of a small increment or decrement to the projected growth of demand, and concentration of the explanation is focused upon marginal capacity cost, i.e., the difference between total system costs with and without the increment or decrement assumed to take place in a specific time period. Three examples of hypothetical capacity expansion are provided to exemplify the fundamental nature of marginal cost, in which one examines the effect upon costs of faster or slower growth in the quantity of water to be supplied, rather than classifying projected expenditures in order to find certain marginal expenses. An extended hypothetical example is given to provide a precise explanation of system marginal costs. Exemplifications and explanations

are also provided to illustrate the concept of marginal cost in the context of water allocation.

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## WATER RESOURCES PLANNING—Field 6

### Evaluation Process—Group 6B

are also given of time-lags, staging, distribution costs, causes of variation in incremental distribution capacity costs, and averaging of marginal costs. (Harris-Wisconsin)  
W77-04170

#### DEVELOPMENT OF COMMERCIAL/INSTITUTIONAL PARAMETER UNITS FOR THE MAIN II SYSTEM OF WATER DEMAND FORECASTING, Wyoming Univ., Laramie. Water Resources Research Inst.

For primary bibliographic entry see Field 6D.  
W77-04182

#### WORKSHOP REPORT INTEGRATING WATER QUALITY AND WATER AND LAND RESOURCES PLANNING.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 476. Price codes: A16 in paper copy, A01 in microfiche. Held at Asilomar Conference Center, Pacific Grove, Calif., January 11-16, 1976, by Univ. Council on Water Resources and the Engineering Foundation. Published by Cornell Univ., Ithaca, NY, 1976. 338 p, 6 append. OWRT C-7508(6514)(1)(S).

Descriptors: \*Planning, \*Comprehensive planning, \*Research priorities, \*Water quality, \*Water resources, \*Land resources, Land management, Management, Technology, Conservation, Water conservation, Evaluation, Institutions, \*Water policy, Programs, Research and development, Systems analysis, \*Coordination, Model studies, Flow augmentation, Flood damage, Flow system.

The Universities Council on Water Resources conducted a workshop on the problems and steps needed to integrate water quality and water and land resources planning. The objectives of the workshop were to: Describe the planning process and administrative arrangements for water quality and water and land resources planning as they actually work and have impact upon investment, regulation and program implementation; Identify the opportunities that are not being realized and problems that are not being met under present policies and practices, specifically along the interface among these areas (water quality and water and land resources planning) at local, regional, state, basin and national levels; Propose changes and improvements in policies and practices that would enhance cooperation, communication and conflict resolution, management efficiency and facilitate more effective impact on the decision-making process considering the limited resources that are and will likely be available to the planning process. Workshop work groups were of two types. Seven work groups looked at problems of integrating water quality and water and land resources planning. These work groups were on flow management, land management, technology application, conservation, evaluation, program and investment strategies, and institutions. The remaining three work groups were concerned respectively with identifying research needs and formulating a research agenda with priorities; with identifying needed public policies; and with refining the tentative systems model (s) that were proposed in a background paper.

W77-04202

A DYNAMIC BALANCED REGIONAL INPUT-OUTPUT MODEL OF POLLUTION CONTROL, State Univ. of New York at Binghamton. School of Management.  
For primary bibliographic entry see Field 5G.  
W77-04209

#### ATTITUDES AND INTERACTIONS OF CITIZEN ADVISORY GROUPS AND GOVERN-

#### MENTAL OFFICIALS IN THE WATER RESOURCES PLANNING PROCESS, Massachusetts Univ., Amherst. Dept. of Political Science.

R. A. Shanley.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 483, Price codes: A06 in paper copy, A01 in microfiche. Massachusetts Water Resources Research Center, Amherst, Publication No. 78, August 1976. 103 p, 28 ref, 3 append. OWRT B-026 MASS(1), 14-31-0001-3895.

Descriptors: \*Water resources development, \*Planning, \*Decision making, \*Social participation, Administrative agencies, Project planning, \*Attitudes, Coordination, Institutions, Institutional constraints, Organizations, Communication, Information exchange.

This case study of citizen advisory committees (CAC's) examined patterns of communication and recruitment in the context of political theory. It is concluded that these patterns placed these programs clearly within the pluralist approach to citizen participation and democracy. The CAC's analyzed were: the Citizens Advisory Committee of the proposed Mount Holyoke Park in Western Massachusetts (working initially with the U.S. National Park service and later with the Massachusetts Department of Natural Resources); the Citizens Advisory Committee of the Charles River Study in eastern Massachusetts (working with the U.S. Army Corps of Engineers); and the Citizens Advisory Committee in the Long Island Sound Regional Study (under the auspices of the New England River Basins Commission). The CAC role in the planning process depended, in part, on the project's organizational structure. Responses to survey questions and revealed that: lead agency officials differed significantly in their perceptions of the uses of CAC's; CAC members also had differing perception of their roles; officials might be willing to grant only slight incremental changes in CAC powers in planning; and some officials had elitist perspectives toward citizen participation while a much smaller number had more fully developed democratic perspectives. These projects revealed that there were either serious problems of communication or coordination (usually both) which hampered the fullest impact of citizen advisory groups in the planning process.

W77-04294

#### BENEFITS FROM WATER POLLUTION ABATEMENT, RECREATION.

National Planning Association, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04299

#### WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, STATE AND LOCAL REVENUE EXPENDITURES.

Data Resources, Inc., Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04305

#### WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, INCIDENCE OF COSTS, DISTRIBUTION OF WATER POLLUTION CONTROL COSTS.

Urban Systems Research and Engineering, Inc., Cambridge, Mass.  
For primary bibliographic entry see Field 5G.  
W77-04306

#### 1975 ANNUAL REPORT NATURAL RESOURCES AND RECREATION AGENCIES, Washington State Office of Program Planning and Fiscal Management, Olympia. Div. of Management and Information Services.

For primary bibliographic entry see Field 6E.  
W77-04357

#### DEPARTMENT OF ECOLOGY, Washington State Dept. of Ecology, Olympia. For primary bibliographic entry see Field 6E. W77-04358

#### OCEANOGRAPHIC COMMISSION, Oceanographic Commission of Washington, Olympia. For primary bibliographic entry see Field 6E. W77-04359

#### THE MEASUREMENT OF ECONOMIC UNCERTAINTY IN PUBLIC WATER RESOURCE DEVELOPMENT, Georgia Univ., Athens. Inst. of Natural Resources.

B. W. Taylor, and R. M. North.  
American Journal of Agricultural Economics, Vol. 58, No. 4, November, 1976, p. 636 - 643. 2 fig, 1 tab, 25 ref. OWRT A-052-GA(2), 14-31-0001-4010.

Descriptors: \*Cost-benefit analysis, Model studies, \*Risks, Measurement, Water resources development, \*Evaluation, \*Simulation analysis, \*Monte Carlo method, \*Georgia.  
Identifiers: \*Spewell Bluff Dam project(Geo), Water resource evaluation.

The existing benefit-cost criteria for evaluating water resource projects are deterministic and therefore incomplete, since the uncertainty inherent in project outcomes is not considered. A Monte-Carlo simulation approach is used to generate a mean and standard deviation for the benefits, costs, benefit-cost ratio, and net present value for the controversial Spewell Bluff Project. Subjective estimates defining probability distributions of project benefits and costs were obtained from the Corps of Engineers. A project selection process that includes probability consideration in the benefit-cost criteria is recommended and several approaches for including uncertainty as a variable are suggested.

W77-04391

#### WHERE CALIFORNIA STANDS ON PLANNING FOR ITS COAST, California Coastal Zone Conservation Commission, San Francisco. For primary bibliographic entry see Field 2L. W77-04463

#### COASTAL-ZONE PLANNING: AN INTEGRATED APPROACH, Nassau-Suffolk Regional Planning Board, N.Y. For primary bibliographic entry see Field 2L. W77-04464

#### THE NORTH CAROLINA COASTAL AREA MANAGEMENT ACT - A PROGRAM OF STATE-LOCAL GOVERNMENT COOPERATIVE PLANNING IN THE COASTAL ZONE, North Carolina Dept. of Natural and Economic Resources, Raleigh.

For primary bibliographic entry see Field 2L.  
W77-04465

#### COASTAL ZONE LEGISLATION: LOUISIANA LANDMARKS, LABYRINTHS AND LOGROLLING, Louisiana State Univ., Baton Rouge. Center for Wetland Resources.

For primary bibliographic entry see Field 2L.  
W77-04466

#### THE ROLE OF PUBLIC PARTICIPATION IN COASTAL ZONE MANAGEMENT: AN ASSESSMENT OF THE ATTITUDES OF RELEVANT INTEREST GROUP LEADERS TOWARDS CZM '72, Texas A and M Univ., College Station. Dept. of Political Science.

## Field 6—WATER RESOURCES PLANNING

### Group 6B—Evaluation Process

J. Dyer, and G. Swanson.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 188-202, 2 fig, 4 tab.

Descriptors: Coasts, \*Resources development, \*Quality control, \*Social aspects, \*Social values, \*Conservation, \*Public rights, Environmental control, Economics, Surveys, \*Social participation, \*Attitudes.

Identifiers: \*Coastal zone management.

The results of a survey conducted among coastal elite interest groups during the past year concerning their views and priorities regarding coastal zone management are presented. The sample consisted of coastal decision-makers in the areas of energy, commercial development and non-extractive coastal business; environmental groups; state, and local authorities and government users of coastal resources. The conflicts and compatibilities of these diverse coastal influences are analyzed in depth. The resources being contested over in the coastal zone are scarce and hence valuable to a number of diverse interest groups resulting in high stakes in the coastal politics game. Interest group positions on coastal use priorities were clearly drawn and was basically determined by interest group affiliation. The most pro-development were the energy/developer groups, along with government users and those most anti-development being the protectionists. State and city officials sought the balance of the two. All groups saw different levels of government having different priorities for coastal zone management, some more and some less closely aligned with their own. (See also W77-04462) (Sinha-OEIS)

W77-04479

**COASTAL LANDFORMS AND SCENIC ANALYSIS: A REVIEW,**  
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

J. P. Felleman.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 203-217, 10 fig, 2 tab, 26 ref.

Descriptors: \*New York, \*Social values, \*Environmental control, \*Landforms, \*Land use, \*Geomorphology, Coasts, Scenery.

Identifiers: \*Coastal zone management.

Scenic quality is related to man's perception of natural and built form. A review is made of three visually related landform description approaches: numerical, geometric, and geomorphic. Diversity and complexity of coastal features are examined. Desirable analysis approaches are found to be sensitive to varying scales, offshore, beach, bluff and upland elements. A visual assessment approach ideally is suitable for both area-wide activity allocation planning and local site design decisions. It is necessary to establish a multi-tiered framework which aggregates characteristic groupings of similar features at the macro scale and utilizes individual landforms or sets of landforms at the local scale. The latter would be applicable to analysis of actual planning and design relating to landscape scenes. (See also W77-04462) (Sinha-OEIS)

W77-04480

**FOCUSING ON VISUAL QUALITY OF THE COASTAL ZONE,**  
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

D. B. Harper.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 218-224, 18 ref.

Descriptors: \*New York, \*Aesthetics, \*Social values, Coasts, \*Scenery, \*Environmental control, Resources development, \*Baseline studies, Management.

Identifiers: \*Coastal zone management, Visual quality.

Consideration of aesthetic values on an equal basis with ecologic, economic, and other values is mandated for planning decisions in the coastal zone. A Sea Grant research program in New York seek to provide use-oriented methods for visual quality protection and control along the state's coastline. (See also W77-04462) (Sinha-OEIS)

W77-04481

#### ASSESSING THE VISUAL QUALITY OF THE COASTAL ZONE,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

T. J. Nieman.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 247-251.

Descriptors: Coasts, \*Resources development, \*Environmental control, Social values, Management, Land use.

Identifiers: \*Coastal zone management, Visual quality.

The visual quality of the coastal zone is an important aspect of coastal management. However, mechanisms for objectivity analyzing visual resources in relation to the perceptions and attitudes of coastal users is not well developed. The problem is further complicated by the diverse nature of the groups utilizing various coastal resources. (See also W77-04462) (Sinha-OEIS)

W77-04485

#### EDUCATION IN LAND USE DECISION MAKING,

E-F Education Services, Hamden, Conn.

L. M. Schaefer.

In: *The Present and Future of Coasts*, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p. 252-262, 4 tab, 12 ref.

Descriptors: \*Land use, \*Resources development, \*Environmental effects, Planning, Coasts, \*Decision making, \*Education.

Identifiers: Coastal zone management.

Land use planning programs are being instituted in many states of our Nation in an effort to sensibly manage our fixed resource of land and to curb environmental pollution that results from improper development procedures. Proper planning programs must be developed to avert the penultimate environmental crisis of grossly over-developed and wasted land. Through the project described in this paper, public school students and representatives of citizen agencies have been exposed to multimedia, individualized curriculum materials on land use decision making which have been developed to reflect the concerns of ecologists, geologists, geographers, economists and demographers. (See also W77-04462) (Sinha-OEIS)

W77-04486

#### ECOLOGICAL MODELING IN A RESOURCE MANAGEMENT FRAMEWORK,

Resources for the Future, Inc., Washington, D.C. For primary bibliographic entry see Field 6G.

W77-04493

#### THE LIMITS OF COST-BENEFIT ANALYSIS AS A GUIDE TO ENVIRONMENTAL POLICY,

Leicester Univ. (England).

For primary bibliographic entry see Field 5G.

W77-04561

**MIDDLE FORK BAYOU D'ARBONNE REServoir PROJECT, CLAIBORNE PARISH, LOUISIANA: A FEASIBILITY AND SOCIAL IMPACT STUDY,**

Louisiana State Univ., Baton Rouge. Center for Agricultural Sciences and Rural Development. Bulletin No. 687, August 1975. 31 p. 4 fig., 20 ref., 2 append.

Descriptors: \*Reservoir sites, \*Project feasibility, \*Louisiana, \*Social impact, \*Economic impact, Recreation, Political aspects, Impoundments, River basin development, Resources development, Attitudes, Relocation, Right-of-way, Rural areas, Regional development, Surveys.

Identifiers: \*Middle Fork Bayou d'Arbonne Reservoir (La), Public opinion surveys, Claiborne Parish (La), Demography, Land acquisition.

A survey-based evaluation of the need and projected effects of a proposed impoundment in Louisiana finds that: (1) Claiborne Parish is in need of development projects of one type or another—including impoundments such as the one proposed if it is to stem the flow of its younger, better educated and more vigorous residents to other regions; (2) The people of the parish are anxious to support the reservoir project, which is seen as a potential economic boost to the area and a source of recreation; (3) The proposed reservoir would not entail exceptional social or economic costs, a consideration which takes into account availability of federally-owned land, the lack of intensively developed land, the fact that relocation would not be a problem and that property acquisition would not involve a large number of holders. The study findings are largely based on a survey of 70 carefully selected persons in the community including rural residents and town dwellers. Selection criteria were that he or she must reside in the parish, must be knowledgeable about what goes on in the parish, and must possess some characteristic or hold a position such that a degree of influence could be exerted on at least some residents of the parish. (Harris-Wisconsin)

W77-04562

#### EFFECT OF WATER QUALITY AND IRRIGATION FREQUENCY ON FARM INCOME IN THE IMPERIAL VALLEY,

California Univ., Davis. Dept. of Agricultural Economics.

For primary bibliographic entry see Field 3C.

W77-04566

#### 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

##### ALTERNATIVE METHODS OF FINANCING WASTEWATER TREATMENT,

Environmental Protection Agency, Washington, D.C. Office of Planning and Evaluation.

For primary bibliographic entry see Field 5G.

W77-04167

##### ANALYZING THE MARGINAL COST OF WATER SUPPLY,

International Labour Office, Geneva (Switzerland).

For primary bibliographic entry see Field 6B.

W77-04170

##### CRITERIA FOR CANDIDATE SPECIES FOR AQUACULTURE,

Groton Associates, Inc., Mass.

H. H. Webber, and P. F. Riordan.

Aquaculture, Vol. 7, No. 2, p. 107-123, 1976. 16 ref.

Descriptors: \*Aquaculture, \*Fish farming, Commercial fishing, \*Fish management, Number fish per acre, Pounds fish per acre, Fish harvest, \*Operating costs, Market value return(Monetary), Varieties, Biological properties, Economics.

Economic and biological parameters that characterize the most probable candidates for an intensive, commercial aquatic animal husbandry industry are considered. All of the criteria fall into three categories. First-category criteria are those that relate to consumer acceptance, and the processing variables that make it possible to market large quantities of the product at favorable prices. The second category involves selection of the species to be farmed on the basis of various biological criteria, including low cost of feeding, ease of propagation, resistance to disease, rapid growth and high survival, factors which promote management in relatively high population density culture systems. The third category of criteria for selection relate to adaptability of the organism to available sites, culture technologies, management systems and financial requirements. Assuming that a market demand for the selected species does exist and that the biological characteristics of the species are appropriate for culture within a developed technology, there is still the question of the commercial suitability of the species. This can only be answered by an entrepreneur willing to risk venture capital in pursuit of a profit. Because of this area of uncertainty, consumer acceptance criteria must also be incorporated into the list of essential requirements for a candidate species. (Harris-Wisconsin)

W77-04171

**INTERNATIONAL COMMODITY CARTELS AND THE THREAT OF NEW ENTRY: IMPLICATIONS OF OCEAN MINERAL RESOURCES**, Arizona State Univ., Tempe. Dept. of Economics. For primary bibliographic entry see Field 6E.

W77-04172

**LAND SUBSIDENCE COSTS IN THE HOUSTON-BAYTOWN AREA OF TEXAS**, Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology. For primary bibliographic entry see Field 2F.

W77-04280

**BENEFITS FROM WATER POLLUTION ABATEMENT, RECREATION**, National Planning Association, Washington, D.C. For primary bibliographic entry see Field 5G.

W77-04299

**WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: CATEGORY 29 INSULATION FIBERGLASS**, Battelle Memorial Inst., Columbus, Ohio. For primary bibliographic entry see Field 5G.

W77-04300

**WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: CATEGORY 16 PAINT AND INK FORMULATION AND PRINTING**, Battelle Memorial Inst. Columbus, Ohio. For primary bibliographic entry see Field 5G.

W77-04301

**WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: CATEGORY 7 DAIRY PRODUCTS**, Battelle Memorial Inst., Columbus, Ohio. For primary bibliographic entry see Field 5G.

W77-04302

**WATER POLLUTION ABATEMENT TECHNOLOGY, CAPABILITIES AND COSTS, SELECTED INDUSTRIES: INDUSTRY CATEGORY 1A, ORE MINING AND MILLING**, Battelle Memorial Inst., Columbus, Ohio. For primary bibliographic entry see Field 5G.

W77-04303

**WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, DIRECT AND CUMULATIVE INDUSTRY IMPACTS**.

Development Planning and Research Associates, Inc., Manhattan, Kans. For primary bibliographic entry see Field 5G.

W77-04304

**WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, STATE AND LOCAL REVENUE EXPENDITURES**.

Data Resources, Inc., Washington, D.C. For primary bibliographic entry see Field 5G.

W77-04305

**WATER POLLUTION CONTROL ACT OF 1972, ECONOMIC IMPACTS, INCIDENCE OF COSTS, DISTRIBUTION OF WATER POLLUTION CONTROL COSTS**.

Urban Systems Research and Engineering, Inc., Cambridge, Mass. For primary bibliographic entry see Field 5G.

W77-04306

**HOW SHOULD INDUSTRY VIEW POLLUTION CHARGES**,

For primary bibliographic entry see Field 5G.

W77-04557

**THE FEASIBILITY OF OYSTER RAFT CULTURE IN EAST COAST ESTUARIES**, Virginia Univ., Charlottesville. Dept. of Environmental Sciences.

For primary bibliographic entry see Field 2L.

W77-04559

**THE EFFICIENCY OF TAXES AND SUBSIDIES IN REDUCING EMISSION BY A RISK-AVERSE FIRM**,

New York Univ., N.Y. Graduate School of Business Administration.

For primary bibliographic entry see Field 5G.

W77-04564

**THE ATLANTIC COAST SURF CLAM FISHERY-1973**,

National Marine Fisheries Service, Oxford, Md. Middle Atlantic Coastal Fisheries Center.

J. W. Ropes, A. S. Merrill, and G. E. Ward. Marine Fisheries Review, Vol. 37, No. 12, p. 31-34, 1975. 6 fig., 2 tab., 6 ref.

Descriptors: \*Fish harvest, \*Commercial fishing, \*Commercial shellfish, \*Marine fisheries, \*Clams, Atlantic Ocean, Maryland, Virginia, Delaware, New York, Fisheries, Coasts, Ships.

Identifiers: \*Surf clams, \*Middle Atlantic Bight.

W77-04173

Surf clams, which supplied 80% of the U.S. total of clam meats by weight in 1973, showed a production increase that year of 19 million pounds over the 62.9 million pounds catch in the Middle Atlantic Bight in 1972, according to a review of fleet operations, landings and other pertinent industry information. A sharp increase in Virginia landings accounted for the record catch. Data is summarized for surf clam vessels and landings for the areas of Chincoteague-Norfolk, Va.; Cape May-Wildwood, N.J.; Ocean City, Md.; Lewes, Del.; Point Pleasant, N.Y.; Atlantic City, N.J.; and Long Island, N.Y. In 1973, 98 vessels made up the surf clam fishing fleet in the bight, a decrease of two vessels from the previous year. Information is supplied on actual landings for the various fleet locations. Vessel captains were interviewed monthly and/or semi-monthly at the various ports, providing data on locations of vessel fishing operations, number of bushels of clams taken during the trip, depths fished, fishing effort, and the size composi-

tion of the catch. An increase in surf clam landings at several ports indicated a general increase in effort in 1973 in response to increased demand. (Harris-Wisconsin)

W77-04565

**6D. Water Demand**

**NEW MEXICO WATER RESOURCES, ASSESSMENT FOR PLANNING PURPOSES**.

Bureau of Reclamation, Amarillo, Tex. S Region 5.

For primary bibliographic entry see Field 6B.

W77-04112

**LAND USE PLANNING: IMPORTANT TOOL FOR CONTROLLING WATER DEMANDS**,

Metcalf and Eddy, Inc., Boston, Mass.

R. L. Ball.

Water and Sewage Works, Vol. 123, No. 7, p. 74-77, 1976. 2 fig., 1 tab.

Descriptors: \*Land use, \*Water demand, \*Water distribution(Applied), \*Planning, Zoning, Alternative planning, Cities, Community development, Distribution systems.

Identifiers: Fire flow.

The impact of land use proposals on water distribution system demands are considered, using the case study method of empirical approach. Based on analysis of a small New England community, three situations were examined: (1) redevelopment of an urban area well within the service area of the existing water distribution system, (2) selection of a specific site from among several alternatives for locating a particular type of development, and (3) selection of a specific land use from the alternatives for a particular site. It is concluded that water system demands and necessary system improvements can be radically changed by land use, and that the most critical land use parameters in determining demand are those directly affecting fire flow demands. Important fire flow considerations include the type of land use and the degree of hazardous occupancy, building height or number of stories, ground floor area, building separation, and type of construction. Zoning regulations usually cover most of these parameters. It was shown that redevelopment, Case 1, could reduce water system demands. Examination of alternative sites, Case 2, indicated that two of the four sites placed much less demand on the water system. Case 3 analysis revealed that garden apartment or single family development caused few water pressure deficiencies, while high-rise apartments, commercial shopping centers, and industrial parks caused increasing demand, respectively. (Luedtke-Wisconsin)

W77-04173

**DEVELOPMENT OF COMMERCIAL/INSTITUTIONAL PARAMETER UNITS FOR THE MAIN II SYSTEM OF WATER DEMAND FORECASTING**,

Wyoming Univ., Laramie. Water Resources Research Inst.

A. G. Thompson, V. E. Smith, and W. R. Colvin. Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 493, Price codes: A04 in paper copy, A01 in microfiche. Completion Report November 1976. 55 p., 5 fig, 16 tab, 18 ref, 2 append. OWRT C-6188(No.5220)(1).

Descriptors: \*Water demand, \*Forecasting, Municipal water, \*Computer models, Industrial water, Institutions, Model studies, Computer programs, Data collections.

Identifiers: \*Municipal water demand, \*Commercial water demand, \*Institutional water demand, Water demand forecasting, Western United States, Main II System.

## Field 6—WATER RESOURCES PLANNING

### Group 6D—Water Demand

Commercial/institutional data were collected for 20 cities in the western United States. Analysis led to the development of linear relationships to predict commercial/institutional parameters from population. Geographic regions and classification by city size were not found to be significant factors. The MAIN II (Municipal And Industrial Needs) water forecasting computer model was modified to include the option of estimating commercial/institutional parameters if the data are not input. Application of the modified model to three test cities gave very good results.

W77-04182

### 6E. Water Law and Institutions

**MONITORING GROUNDWATER QUALITY: ECONOMIC FRAMEWORK AND PRINCIPLES,** General Electric Co., Santa Barbara, Calif. Center for Advanced Studies. For primary bibliographic entry see Field 5A. W77-04113

**THE GEOLOGIC ASPECTS IN THE PLANNING AND IMPLEMENTATION OF THE PENNSYLVANIA SOLID WASTE MANAGEMENT ACT, ACT 241,** Pennsylvania Dept. of Environmental Resources, Harrisburg. For primary bibliographic entry see Field 5G. W77-04125

**SUMMARY OF SELECTED COURT CASE IN WATER CONSERVATION AND GROUNDWATER LITIGATION,** Arizona Univ., Tucson. W. A. Martin, and G. H. Erickson. Agricultural Research Service, Phoenix, United States Water Conservation Laboratory Report Number 10, July, 1976, p 24.

Descriptors: \*Water law, \*Water wells, \*Groundwater, \*Surface water, \*Aquifers, \*Legal aspects, Judicial decisions, Prior appropriation, Riparian rights, Water rights, Surface-groundwater relations.

Identifiers: \*Water conservation litigation, \*Groundwater litigation, Selected court cases.

Legal and institutional aspects of water conservation and groundwater management are important elements in water-oriented research and operational programs. Since this information is not readily in most hydrology literature, various court cases have been selected, reviewed and summarized from several western states for this report. The cases are grouped to provide answers to nine questions. These questions include: (1) the legal aspects of the reuse of wastewater; (2) the right to an increase in streamflow due to vegetation management or large-scale water harvesting, (3) claims on canal seepage losses, (4) the right to water saved by clearing a flood plain of phreatophytes, (5) groundwater recharge effects on water levels in gravel pits and the gravel mining operations, (6) the use of aquifers as storage and transmission facilities by recharge and pumping, (7) the appropriation of water in cases of stream, aquifer, direct hydraulic connection, (8) the right of the owner of a free-flowing well, in the face of groundwater development in the area, (9) the compensation of a well owner whose well yield has been decreased by wells installed at later dates. (Heiss-NWWA) W77-04139

**ISSUES AND OPINIONS ON THE SOCIAL EFFECTS OF WATER ALLOCATION FOR COAL DEVELOPMENT IN THE YELLOWSTONE RIVER DRAINAGE,** Montana State Univ., Bozeman. For primary bibliographic entry see Field 6B. W77-04146

### THE LAKE TAHOE STUDY...AS REQUESTED BY THE 92ND CONGRESS IN SECTION 114 OF THE FEDERAL WATER POLLUTION CONTROL ACT OF 1972.

Environmental Protection Agency, San Francisco, Calif. Surveillance and Analysis Div. For primary bibliographic entry see Field 5G. W77-04168

**INTERNATIONAL COMMODITY CARTELS AND THE THREAT OF NEW ENTRY: IMPLICATIONS OF OCEAN MINERAL RESOURCES,** Arizona State Univ., Tempe. Dept. of Economics. R. C. Amacher, and R. J. Sweeney. Kyklos, Vol. 29, No. 2, p. 292-309, 1976. 1 fig., 2 tab., 27 ref.

Descriptors: \*Oceans, \*Mining, Copper, Nickel, Supply, Demand, Cobalt, Manganese, Monopoly, Competition, Economics, Costs, Income.

Identifiers: \*Ocean mining, \*Cartels.

The economics of deep-sea mining are examined to demonstrate that some form of free market deep-sea exploitation will effectively deter an OPEC type of cartelization at the international market level for several primary minerals, particularly copper and nickel. The entry price for ocean mining is calculated and the influence of deep-sea mining on the ability of potential cartels to extract monopoly rents is discussed. An analysis of cartel behavior indicates that they are more likely to succeed if: (1) the lower is the market price of byproducts of competing suppliers, (2) the larger is the byproduct relative to the cartel's product, (3) the less elastic the demand for the byproduct, and (4) the larger is the share of the byproduct in competitors' total revenues. Using the highest projected costs but only average yields from mining of the better deep seabed sites in the North Pacific, it is shown that ocean mining represents a significant threat to OPEC-type organizations if they are unable to control mining of the deep seabed. Even on the worst-case assumption that only land based producers mine the ocean, the increase in productive capacity will increase the revenue made by chiseling and increase the likelihood of cartel collapse. It is concluded that there will be little danger for ocean-based rather than land-based cartelization to be effective because of the elasticity of the excess demand curve facing ocean miners. (Luedtke-Wisconsin) W77-04172

### LEGAL ASPECTS OF LAND USE REGULATION OF LAKE SHORELANDS BY STATE AND LOCAL GOVERNMENTS FOR THE PROTECTION OF LAKES,

Texas Univ. at Austin. Center for Research in Water Resources. C. W. Johnson, and T. C. Fitzhugh, III. Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 478, Price codes: A05 in paper copy, A01 in microfiche. Technical Report CRWR-142, December 1976. 84 p, 4 tab. OWRT A-036-TEX(1), 14-31-0001-7091, 14-34-0001-7092.

Descriptors: \*Lakes, \*Land use, Local governments, \*Regulation, Water law, Legal aspects, \*Lake shores, State governments, Shores, Programs, Surveys.

Results are presented of a comprehensive survey and analysis of the legal aspects of land use regulation by state and local governments of shorelands for the protection of lakes. Representative early limited purpose programs and all modern comprehensive lake shorelands programs in the United States were examined. Significant variations in programs were identified, with special reference to innovative features of modern programs. W77-04175

### THE NATIONAL FLOOD INSURANCE PROGRAM—A MODEL ORDINANCE FOR IMPLEMENTATION OF ITS LAND MANAGEMENT CRITERIA,

Florida Univ., Gainesville. School of Law. For primary bibliographic entry see Field 6F. W77-04186

**THE EXTENT TO WHICH MARINE TRANSPORTATION WITHIN THE ECONOMIC ZONE WILL BE AFFECTED BY ENFORCEMENT OF THE PROPOSED POLLUTION CONTROLS,** Woods Hole Oceanographic Institution, Mass. Dept. of Applied Oceanography. For primary bibliographic entry see Field 5G. W77-04194

**WORKSHOP REPORT INTEGRATING WATER QUALITY AND WATER AND LAND RESOURCES PLANNING.** For primary bibliographic entry see Field 6B. W77-04202

**ATTITUDES AND INTERACTIONS OF CITIZEN ADVISORY GROUPS AND GOVERNMENTAL OFFICIALS IN THE WATER RESOURCES PLANNING PROCESS,** Massachusetts Univ., Amherst. Dept. of Political Science.

For primary bibliographic entry see Field 6B. W77-04294

**PUBLIC LAW 92-500 ECONOMIC AND SOCIAL IMPACTS: TECHNICAL VOLUME.** National Commission on Water Quality, Washington, D. C. For primary bibliographic entry see Field 5G. W77-04307

**FARMERS, FEEDLOTS AND FEDERALISM: THE IMPACT OF THE 1972 FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS,** Stanford Univ., Calif. School of Law. For primary bibliographic entry see Field 5G. W77-04347

**RIGHTS OF IMPORTERS AND DEVELOPERS OF WATER: DENVER V FULTON IRRIGATING DITCH COMPANY,** D. Riggs. Land and Water Law Review, Vol. 9, p. 543-552 (1974). 41 ref.

Descriptors: \*Imported water, \*Developed waters, \*Colorado, \*Diversion, \*Appropriation, Water supply, Effluents, Recycling, Economic efficiency, Judicial decisions, State governments, River basins, Water management(Applied), Rivers, Legal aspects, Water pollution, Cycles. Identifiers: \*Denver water supply, \*Successive use, \*Right of disposition, Identification of imported water.

The Colorado Supreme Court has held that, in the absence of an agreement on its part not to do so, an importer of water may re-use, make successive use of, and, after use, may make disposition of imported waters. The importer here was the City of Denver who diverted water from the Colorado River Basin for domestic and industrial purposes. The Court's decision arose in response to a downstream user's complaints over the discontinuance of the foreign water flow occasioned by the city's sale of its treated effluent to the Adolf Coors Company. Also examined is the rule that an importer need not maintain actual possession of the water to make further use of it; instead, he need only identify it from the naturally flowing water. Two advantages of the re-use process are noted: the importer can reduce the quantity of water diverted, and a closed cyclic process can be established which will reduce the amount of pol-

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## WATER RESOURCES PLANNING—Field 6

### Water Law and Institutions—Group 6E

luted water released into public waterways. The author foresees this process as providing both economic gain and societal benefit. (Moorhouse-Florida)  
W77-04348

#### WATERGATE VILLAGE: A CASE STUDY OF A PERMIT APPLICATION.

Maryland Univ., Baltimore. School of Law.  
G. Power.

Coastal Zone Management Journal, Vol 2, No 2, p 103-124 (1975). 22 p, 5 fig, 24 ref.

Descriptors: \*Maryland, \*Permits, \*Administrative agencies, \*Marinas, \*Harbors, State governments, Federal government, Coastal structures, Legal aspects, Regulation, Environment effects, Land use, Land development, Governmental interrelations, Political aspects, Social aspects, Water resources development, Rivers and Harbors Act.  
Identifiers: Certification, Licenses, Administrative regulations, Annapolis(Md).

On May 7, 1973, Watergate Village, an apartment complex in Annapolis, Maryland, applied to the Army Corps of Engineers for permission to expand its marina facility. Under the River and Harbors Act of 1899 the Corps of Engineers is the lead federal agency for the evaluation of such requests. In this instance, however, both the EPA and the Maryland Water Resources Administration were asked to review the application. Both agencies commented unfavorably. Subsequently, Watergate Village submitted a revised application. The second application was approved by state authorities, but federal authorization was withheld. Watergate Village was also required to submit the plans to the City of Annapolis for approval. The regulatory process which governed the permit application presented a labyrinth of duplicative and redundant decision-making. Notwithstanding the profusion of regulatory activity, the process was inadequate to effectively evaluate the effect of the marina project on the overall development of the area. While the Corps of Engineers has the legal power to rule on an application in light of the public interest, it lacks the manpower and finances to do so effectively. As a result, the Corps functions as a clearing house for recommendations from other governmental agencies, rather than as lead review agency. The Corps needs to develop administrative procedures which facilitate permit application, and which allow consideration of the cumulative impact of a series of coastal alterations. (Moorhouse-Florida)  
W77-04349

LOUISIANA TIDELANDS PAST AND FUTURE, Louisiana Office of the Attorney General, Baton Rouge.  
W. J. Guste, Jr. and F. W. Ellis.  
Loyola Law Review, Vol. 21, p. 817-833 (Fall 1975). 1 fig, 36 ref.

Descriptors: \*Louisiana, \*Oil fields, \*Federal-state water rights conflicts, \*Ownership of beds, \*Boundary disputes, Oil wells, Oil industry, Oil, Natural gas, Natural resources, Bayous, Channels, Drilling, State jurisdiction, Federal jurisdiction, Water law, Beds under water.  
Identifiers: \*Coastal waters, \*Coastal zone management.

Major questions still exist as to the ownership of submerged beds of offshore waters. California and Louisiana leased offshore rights in the 1920's, but in 1945 the federal government claimed all rights to the beds, as well as the oil resources. This resulted in the beginning of a line of Supreme Court cases from 1947-50 which affirmed federal rights. To correct this imbalance, the coastal states succeeded in having the Submerged Lands Act passed in 1953. This Act recognizes coastal state maritime boundaries of three miles. Louisiana and the Secretary of the Interior subsequently came up

with two different coastal lines, and the issue was ultimately decided by a Supreme Court appointed Master. Louisiana finally got title to 75,000 of the more than 200,000 acres still in dispute by 1964. The author suggests that coastal states should get a large share of the revenue from offshore operations because of the environmental harm such operations often cause. (Frank-Florida)  
W77-04350

#### THE COAST: WHERE ENERGY MEETS THE ENVIRONMENT,

San Diego Univ., Calif. School of Law.  
R. G. Hildreth.  
San Diego Law Review, Vol 13, No 2 p 253-305 (1976). 53 p, 292 ref.

Descriptors: \*Federal-state water rights conflicts, \*Environmental effects, \*Water resources development, \*Continental shelf, \*Jurisdiction, Coasts, Shore protection, Oil spills, State governments, Federal government, Legislation, Mineral industry, Oil, Deep water habitats, Administrative decisions, Water pollution.  
Identifiers: \*Coastal Zone Management Act(CZMA), \*Deepwater Port Act of 1974.

The development of the outer continental shelf (OCS) is necessary to meet the future energy needs of the nation. Such development will not be without impact, both beneficial and harmful. Dredging and filling of wetlands, air and water pollution from refineries, and chronic oil pollution can be expected to cause serious environmental damage over extended periods of time. Impacts on the coastal environment from OCS development could in the long run be significant enough to outweigh any short-run gains from exploitation of shelf resources. Since it will be the states who suffer from the development, these issues have placed the greatest strain on federal-state relations since school integration. A decision-making process is needed which accounts for the various interests at stake in reaching feasible solutions to energy problems. The two extremes among the models available are the Deepwater Port Act, which gives states a veto, and preemptive federal siting of energy facilities. However, for energy programs with coastal impacts, the Coastal Zone Management Act (CZMA) process seems desirable. The CZMA preserves federalism in energy decisions, emphasizing the role of the states as mediator between national and local government levels. The use of this process should test the viability of federalism in energy decisions. (Frank-Florida)  
W77-04351

#### THE CASE OF THE INCIDENTAL LORSTER: UNITED STATES REGULATION OF FOREIGN HARVESTING OF CONTINENTAL SHELF FISHERY RESOURCES,

Le Boeuf, Lamb, Leiby and MacRae, Washington, D. C.  
E. R. Fidell.

International Lawyer, Vol 10, p 135-152 (Winter 1976). 18 p, 85 ref.

Descriptors: \*International commissions, \*Law enforcement, \*Continental shelf, \*Fisheries, \*Lobsters, Legal aspects, Fish, Fishing, Fish management, Federal government, Federal jurisdiction, Coast Guard regulations, Legislation, Law of the sea, International waters, New England.  
Identifiers: \*Coastal waters.

In 1974 the Executive Branch was faced with growing congressional interest in deterring foreign harvesting of lobsters off New England, and it started a more aggressive program of enforcement in continental shelf cases. Two diplomatic notes informed other nations of changes in American policy. They respectively warned that any vessel taking fishery resources from the Shelf would be subject to seizure, and then explained the

procedures for specific enforcement of the new policy. The Bartlett Act is the vehicle for this enforcement. Since its passage in 1964, enforcement has increased dramatically. The Act provides for Coast Guard seizures, with or without a warrant, and makes it illegal for any foreign-flag vessels to engage in Continental Shelf fishing without express approval by the United States. Seizures of various foreign fishing boats under the Act are detailed. The author concludes that bilateral agreements should be made where possible to prevent international friction; however, where such agreements are not present, the United States should not hesitate to continue making enforcement a reality. (Frank-Florida)  
W77-04352

#### LOS III: PROSPECTS AND PROBLEMS,

Johns Hopkins Univ., Washington, D. C. Ocean Policy Project; and Johns Hopkins Univ., Washington, D. C. School of Advanced International Studies.

A. L. Hollick.  
Columbia Journal of Transnational Law, Vol 14, No 1, p 102-11 (1975). 10 p.

Descriptors: \*Continental shelf, \*Water resources development, \*Law of the sea, \*Jurisdiction, \*United Nations, Ships, International law, International waters, Coastlines, Treaties, Foreign trade, Oceans, Legal aspects, Navigation, Foreign countries, Governments, Resource allocation, Resources development, Resources, Coasts, United States.  
Identifiers: \*Territorial seas(Jurisdiction), \*Economic zones.

The goal of the Third United Nations Conference on the Law of the Sea (LOS III) is to produce a single treaty that is both comprehensive and widely accepted. The attainment of this goal is questionable for two reasons: First, the size of the agenda presents numerous problems with issues ranging from shipping to the mining of hard minerals. The author believes these problems will be traded off in a political package. Efficient long term management systems will not be developed. Secondly, the large number of participants makes negotiating difficult. Ideological, regional and geographic differences make common agreement on any issue almost impossible. The real winners of the Conference will be the United States and other countries with extensive coast lines as there is sentiment for 12-mile territorial seas and 200-mile resources zones. Under this plan the United States would gain 2.2 million square miles more than any other nation. This territorial extension is a foregone conclusion since nations will unilaterally make the extension if no treaty is passed. Due to the rigidity and political orientation of the Conference's proposals, the better course might be to postpone any treaty until more efficient management systems of the ocean's resources are developed. (Moorhouse-Florida)  
W77-04353

#### THE DEGREE OF EFFECTIVENESS OF INTERNATIONAL LAW AS REGARDS INTERNATIONAL RIVERS,

Egyptian Embassy, Hague (Netherlands).

A. Fahmi.  
In: Proceedings of the International Conference on Water Law and Administration, International Association for Water Law, February 8-14, 1976, Caracas, Venezuela; published by the Commission for the National Water Resources Development Plan (COPLA-NARH), Caracas, Venezuela, p. 188-201, 1976. 16 ref.

Descriptors: \*International law, \*Treaties, \*Foreign waters, \*Riparian rights, \*Rivers, Bodies of water, Running waters, International waters, Inland waterways, Judicial decisions, Legal aspects, River basins, River flow, Navigable rivers, Drainage systems.

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

International law concerning international rivers is a mixture of treaty and custom. The vast majority of nations assert that international law, while respecting territorial sovereignty, and should recognize the right of every riparian nation to enjoy the advantages to be derived from a common river. The principle of free navigation has been followed for many years on the Danube, Congo, Niger and Amazon rivers. The increasing number of judicial and arbitral decisions shed light on various rules of law which have proved none too clear. The author cites the following rules as having gained the approval of judicial and arbitral tribunals: (1) a nation must take into consideration the interests of all co-riparian nations which may be affected by works undertaken; (2) a nation may not alter the natural conditions within its territory to the detriment of natural conditions within a neighboring nation; and (3) the doctrines of riparian rights, equitable apportionment and acquired rights should control in the absence of custom or legislation to the contrary. While these rules all apply through custom, legislation or state decisions, there is an urgent need to clarify and codify them either by compact or treaty. (Frank-Florida) W77-04354

#### WATER LAWS OF THE UNITED STATES: THE DEFICIENCIES AND DEGREE OF EFFECTIVENESS,

Department of Justice, Washington, D. C. Land and Natural Resources Div.

W. J. Kiechel.

In: Proceedings of the International Conference on Water Law and Administration, International Association for Water Law, Feb. 8-14, 1976, Caracas, Venezuela; published by the Commission for the National Water Resources Development Plan (COPLANARH), Caracas, Venezuela, p 158-168, 1976. 11 p, 5 ref.

Descriptors: \*Federal-state water rights conflicts, \*Jurisdiction, \*Reservation doctrine, \*Riparian rights, \*Prior appropriation, Federal government, State governments, Regulation, Groundwater, Legislation, Judicial decisions, Legal review, Federal jurisdiction, Surface waters, Legal aspects, Water rights, Water law.

Water law in the United States is a dual system with the authority and jurisdiction over water resources divided between federal and state governments. The water law of the states is basically either the riparian doctrine or the doctrine of prior appropriation. A conference on water law recommended modification of state laws to: (1) provide a simple method for a change in permitted use of water; (2) recognize a water right for environmental purposes; (3) regulate groundwater as well as surface water; and (4) encourage water conservation. The basis of federal water law is the reservation doctrine. The federal government owns approximately one-third of the land area of the fifty states and controls the waters arising on these lands. Currently, information about the extent of these reserved rights is difficult to obtain. The author suggests a need for legislation requiring an inventory and quantification of federal water rights so that states may determine the impact of federal water rights on state law. (Capehart-Florida) W77-04355

#### WATER LAW AND ADMINISTRATION IN THE UNITED STATES,

Colorado State Univ., Fort Collins.

G. E. Radosevich, and D. R. Daines.

In: Proceedings of the International Conference on Global Water Law Systems, International Association for Water Law, September 1-9, 1975, Valencia, Spain; published by Colorado State University, Ft. Collins, Colo. 80523, p 453-502, 1976. 50 p, 11 fig, 53 ref.

Descriptors: \*Water management(Applied), \*State governments, \*Federal government,

\*Administration, Planning, Political aspects, Social aspects, Legal aspects, Water conservation, Water resources, Water supply, Administrative agencies, Governmental interrelations, Interstate, State jurisdiction, Water resources development, Regulation, Management, Water quality standards.

Water law in the United States is not a unitary system but rather a bifurcated system composed of federal and state laws dealing with the quantity and quality of water. Federal authority over resources is derived from the Property, Commerce, General Welfare and Treaty powers of the constitution. Traditional federal activities in relation to water resources include navigation, pollution abatement and allocation and management of water resources. Each state is a separate political entity with varied and particular needs and consequently develops policies, laws and organizations according to its individual needs. This results in lack of uniformity among the states which usually leads to interstate conflicts. Traditional state activities in relation to water resources include water allocation, distribution and administration. Over the past ten years population shifts, industrialization, energy development, increased needs for food and fiber and new technologies have forced both state and federal governments to move more strongly into the field of water management. Consequently, water law systems throughout the United States are in a dynamic and evolutionary process. Such systems can constantly benefit by an awareness of experiences in any nation. (Moorhouse-Florida) W77-04356

#### 1975 ANNUAL REPORT NATURAL RESOURCES AND RECREATION AGENCIES,

Washington State Office of Program Planning and

Fiscal Management, Olympia. Div. of Management and Information Services.

L. M. Buffington.

(1975). 76 p, 5 fig, 4 tab, 29 chart.

Descriptors: \*Washington, \*Administrative agencies, \*Natural resources, \*Recreation, Cooling water, Irrigation, Agriculture, Nuclear powerplants, Rivers, Fisheries, Fish, Wildlife management, Forest management, Salmon, Thermal power, Parks, Planning, State governments, Land management, Wildlife conservation, Research and development, Evaluation, Pesticides.

Identifiers: Land acquisition, Land development.

Summarized here are the 1975 activities of Washington state agencies working in the area of natural resources and recreation. The Department of Agriculture has recommended an expansion of the irrigated acreage in the state to meet the state goal of developing a farm-based economy rather than relying on industrial growth. Meanwhile, the Department of Commerce and Economic Development has supported a program for improving Columbia and Snake River fisheries, and the Division of Nuclear Development has established a project to study the use of powerplant cooling water for irrigation purposes. The Department of Fisheries reported on its management programs for shellfish, marine fish, and salmon. A table of food fish statistics is included. The Department of Game summarized its efforts to protect fish and wildlife. The Interagency Commission for Outdoor Recreation assisted state and local agencies in the acquisition and development of recreation lands. The Department of Natural Resources carried out activities related to its role as manager of the state upland and aquatic lands. Sixteen pages of tables showing these activities are included. Other reporting agencies are the Parks and Recreation Commission and the Thermal Power Plant Site Evaluation Council. (See W77-04358 thru W77-04360) (Capehart-Florida) W77-04357

#### DEPARTMENT OF ECOLOGY.

Washington State Dept. of Ecology, Olympia.

J. A. Biggs.

In: 1975 Annual Report Natural Resources and Recreation Agencies, p. 15-19, State of Washington. 1 fig, 1 chart.

Descriptors: \*Washington, \*Water pollution control, \*Water resources development, \*Administrative agencies, Ecology, Law enforcement, Water resources, Sewers, Land use, Solid wastes, Water management(Applied), Shores, Agricultural runoff, Water rights, Water quality, Permits, Watersheds(Basins), Wells, State governments, Air pollution, Watershed management, Water policy, Water quality control.

Identifiers: Coastal zone management.

The Washington Department of Ecology is charged with maintaining a high quality of life in the state. The department approves funds for such community projects as new sewers, clean air, garbage problems, and land use. Water quality projects for 1975 included a large sewage treatment plant, an agricultural water pollution control program, and enforcement of the state's water pollution control laws. The primary water resource management activity was the proposed revision to the state water code. Long-range water management study plans were implemented for four basins. Another major area of departmental efforts was the shoreline management program. Solid waste, air quality, litter control, and noise control were other areas of concern for the department. Charts included show the number of water right applications yearly from 1967 to 1975, the annual dollar amount of civil penalties collected for water pollution violations for 1971 to 1975, the dollar amount of environmental grants given in 1975 to local agencies, and the amount of sewage construction grant funds given for 1970 to 1975. (See also W77-043571) (Capehart-Florida) W77-04358

#### OCEANOGRAPHIC COMMISSION,

Oceanographic Commission of Washington, Olympia.

B. G. Ledbetter.

In: 1975 Annual Report Natural Resources and Recreation Agencies, p. 57-62, State of Washington. 1 chart.

Descriptors: \*Washington, \*Feasibility studies, \*Oil, \*Transportation, \*Oceans, Water quality, Instrumentation, Jurisdiction, Economic impact, Social impact, Cost-benefit analysis, Pipelines, Natural gas, Oil spills, Conferences, Buoys, Weather forecasting, Weather data, Data collections, Networks, Coastal structures, Oceanography, Project planning, State governments, Administrative agencies, Model studies, Sites.

Identifiers: Offshore transfer systems.

The major effort of the Oceanographic Commission of Washington in 1975 was the study of offshore petroleum transfer systems. The study was concerned with the feasibility of offshore systems in terms of engineering, environmental, economic, social and jurisdictional factors. Costs, benefits, advantages, disadvantages, and impacts were analyzed. Other activities undertaken by the commission included a submarine oil pipeline site location study, a liquefied natural gas alternate site study, a literature search of oil-spreading models, a compendium for Washington waters of current environmental studies planned or in progress, and a water quality instrumentation symposium. The commission has a continuing project of promoting the establishment by the National Oceanic and Atmospheric Administration of a national data buoy network deployed from the state of Washington. This system should provide more accurate long-range weather forecasts. (See also W77-04357) (Capehart-Florida) W77-04359

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## WATER RESOURCES PLANNING—Field 6

### Water Law and Institutions—Group 6E

**POLLUTION CONTROL HEARINGS BOARD  
SHORELINES HEARINGS BOARD COUNCIL  
ON ENVIRONMENTAL POLICY,**  
Washington State Pollution Control Hearing  
Board, Olympia.  
C. Smith.

In: 1975 Annual Report Natural Resources and  
Recreation Agencies, p. 71, State of Washington.

Descriptors: \*Washington, \*Legal review, \*Water rights, \*Penalties(Legal), \*Water pollution control, Pollution, Administrative agencies, State governments, Oil spills, Permits, Flood plain zoning, Discharge(Water), Taxes, Construction, Pollution taxes(Charges), Regulation, Assessments, Water permits, Environmental control, Shore protection, Shores, Air pollution.  
Identifiers: \*Coastal zone management, Environmental impact statements, Public hearings.

The function of the Pollution Control Hearings Board is to review appeals from decisions of the local air pollution control agencies and the Department of Ecology. In 1975 the area of water rights generated the most appeals. Other areas of appeal included oil spill penalties, water right permits, flood plain zoning, construction permits, water discharge permits and penalties, and pollution control equipment tax credit decisions. The Shorelines Hearings Board reviews decisions on shoreline development proposals and disagreements on local governmental master programs for shoreline development. In 1975, requests for review were reduced by 40% over 1974. The Council on Environmental Policy, established in 1974 and due to terminate in 1976, has the responsibility for adopting rules of interpretation and implementation of the 1971 State Environmental Policy Act. The Council on Environmental Policy held public hearings on its proposed guidelines and is to adopt final regulations effective in early 1976. Public workshops are to be held to explain the guidelines. (See also W77-04357) (Capehart-Florida)  
W77-04360

**PROTECTION AND CONTROL OF THE SALT WATER SHORE AREA,**  
Rhode Island Statewide Planning Program, Providence.  
D. W. Varin, and S. P. Morrison.  
Technical Paper No. 21, p ii-39, May 1972. 41 p, 9 photo map.

Descriptors: \*Rhode Island, \*Coasts, \*Shore protection, \*Zoning, \*Public rights, Public lands, Shores, High water mark, Priorities, State governments, Compensation, Damages, Environment, Environmental control, Properties, Legislation, Constitutional law.  
Identifiers: \*Taking(Constitutional), Coastal critical areas, \*Coastal development, Private property rights, Police power.

Examined here is the need for legislative control over the use and development of Rhode Island's coastal land. The great environmental and economic interests in coastal property is probably sufficient justification for imposing restrictions on private rights of ownership of coastal property. To begin, a delineation of critical areas should be made to include those narrow strips of coastal land extending from the high water line landward to a parallel line located by the application of several criteria. These critical areas would be subject to specific zoning requirements intended to promote coastal use and development in the best public interest. Very possibly private owners of shoreline property would be able to demand compensation for imposition of these land use restrictions even though the restrictions themselves might be justified by the state's police power. Therefore, the legislation designating the critical areas should be designed to give the state a case-by-case option either to render necessary compensation or to withdraw the legislation to the extent it affects the protesting private owner. (Josephher-Florida)  
W77-04361

**THE COASTAL INTERFACE: WHO OWNS WHAT,**  
Florida Univ., Gainesville. School of Law.  
G. W. Maxwell, III.

Available from Eastern Water Law Center, University of Fla., Gainesville, Fla. 32611. \$2.30. Environmental Law Seminar, Spring 1976, 46 p.

Descriptors: \*Interfaces, \*Florida, \*Coasts, \*Boundary processes, \*Accretion(Legal aspects), Oceans, Seashores, Shores, Legal aspects, Boundaries(Property), Regulation, Water law, Water rights, Administration, Beaches, Preservation, Competing uses, Legislation.

A perplexing problem of law concerns the ownership of the coastal interface. This paper examines the attempts by the state of Florida to stabilize its coastline and to regulate it in an effort to determine such ownership. The basis for regulation of the Florida coastline is the Beach and Shore Preservation Act; the vehicles are the Department of Natural Resources and its Division of Marine Resources. The paper discusses the role of federal authorities, such as the Corps of Engineers, in beach and shore preservation programs and the effect of the Coastal Zone Management Act of 1972. The problem with defining state ownership and private ownership demarcation is compounded by the use of the term 'mean high water mark', and the determination of such line. The author recommends expansion of the legislation in this area, and the imposition of a stricter coastal construction setback line. (Covart-Florida)  
W77-04362

**POWER PLANT SITING: CAUGHT BETWEEN ENERGY CRISIS AND ENVIRONMENTAL CONCERN,**  
Florida Univ., Gainesville. School of Law.  
K. T. Connor.

Available from Eastern Water Law Center, University of Florida, Gainesville, Florida 32611. \$1.90. Environmental Law Seminar, Fall, 1973, 38 p.

Descriptors: \*Electric power plants, \*Hydroelectric plants, \*Nuclear powerplants, \*Thermal powerplants, Sites, Federal Power Act, Clean Air Act, Rivers and Harbors Act, Federal Water Pollution Control Act, Administration, Permits, Construction, Administrative decisions, Electric power production, Environmental effects. Identifiers: \*Environmental impact statements, \*Administrative regulations, \*National Environmental Policy Act.

Concern over environmental protection has led the federal, state and local governments to adopt extensive permit and review procedures pertaining to power plant siting. The effective protection of the environment remains elusive, however, especially when placed in balance with increasing energy needs. The National Environmental Policy Act (NEPA) requires the filing of Environmental Impact Statements (EIS) before any major federal action is undertaken. NEPA therefore prohibits construction without environmental consideration and requires consideration of alternatives before site selection. Nevertheless, the requirements can sometimes be avoided. For example, nuclear power plants, licensed under the Atomic Energy Commission (AEC), may not be constructed without a permit. Site acquisition, however, is not prohibited. If the AEC denies a license, the facility may switch to fossil fuels, obtain a license from the Corps of Engineers and use the prohibited site. The Corps is not required to file an EIS unless air or land quality is affected. The Federal Power Commission, which primarily has jurisdiction over hydroelectric plants, is the only licensing agency with both the power and duty to evaluate sites. (Comer-Florida)  
W77-04363

**THE FLOOD PLAIN ZONING EXPERIENCE IN THE GREAT LAKE STATES,**  
Florida Univ., Gainesville. School of Law.  
R. A. Walter.

Available from Eastern Water Law Center, University of Florida, Gainesville, Florida 32611. \$1.25. Environmental Law Seminar, Spring 1975, 25 p.

Descriptors: \*Great Lakes region, \*Flood plain zoning, \*Flood routing, \*Flood control, Iowa, Indiana, Illinois, Minnesota, Michigan, Wisconsin, Floodways, Flood protection, Legislation, Administrative agencies, Regulation, Permits, Building codes, Flood damage, Design standards, Flood data, Flood plain insurance, Maximum probable flood, Flow control, Reasonable use, Land tenure, Flood forecasting, Flood plains, Flood profiles.

In an effort to comply with comprehensive federal flood control legislation, the Great Lakes States, Iowa, Illinois, Indiana, Wisconsin, Minnesota and Michigan, have all attempted to define and regulate flood plain areas. Although each of the states has adopted a slightly different approach from the others, all plans have similar characteristics and face similar problems. Each state has attempted to define a floodway system and floodway fringe areas based on the 100 year flood as required by federal law. None of the states, however, has adequate data to accurately establish the areas. This is generally because acquisition of data is costly and time consuming. Therefore the prevailing method of definition is by estimate based on known data which may or may not adequately protect. In addition, all states are subject to pressures from landowners in flood plain areas with a common result that regulation measures are often inadequate. Zoning ordinance enforcement is difficult. Political and economic pressures are constant. Despite the difficulties, these states are at least attempting to control flood damage. (Comer-Florida)  
W77-04364

**GARRISON DIVERSION UNIT IRRIGATION PROJECT: PROSPECTS AND PROBLEMS,**  
PART 2.

Hearings—Sub Comm of Com on Government Operations—USH of Rep., November 19, 1975, p 1-419. 419 p.

Descriptors: \*North Dakota, \*Water quality, \*Diversion structures, \*Irrigation systems, Irrigation, Canada, Rivers, Desalination, Wetlands, Wildlife, Wildlife habitats, Environmental effects, Hydroelectric power, Structures, Canals, Sprinkler irrigation, Irrigation water, Brackish water, Salinity, Treaties.  
Identifiers: \*Congressional hearings.

Various governmental agencies participated in the hearing conducted by the Conservation, Energy and Natural Resources Subcommittee on the environmental and economic problems associated with the Garrison Diversion Unit irrigation project. The Council on Environmental Quality recommended that new construction activities be delayed because of problems pointed out in the environmental impact statement. These problems include adverse impacts on water quality in both the United States and Canada; adverse effects on wildlife habitats; loss of agricultural land to the project; disruption of groundwater supplies. The Department of the Interior discussed coal development in the project area and the effects on Canada of return flows from the project. The Fish and Wildlife Service was concerned about the loss of 146,000 acres of wildlife habitat to the project. The Environmental Protection Agency said the major environmental problems were with use of the completed project rather than its construction. A major concern was the increase in the salinity of water flows into Canada. The Department of State also testified on the Canadian problem. (Capehart-Florida)  
W77-04365

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

**NAVIGABLE WATER OF THE STATE OF ARIZONA; WATER QUALITY STANDARDS.**  
Environmental Protection Agency, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04366

**OIL POLLUTION PREVENTION.**  
Environmental Protection Agency, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04367

**BUTADIENE LIMITATIONS, GUIDELINES AND STANDARDS; AMENDMENT.**  
Environmental Protection Agency, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04368

**MARSHALL FORD DAM AND RESERVOIR, COLORADO RIVER, TEXAS; REVISION OF FLOOD CONTROL REGULATIONS.**  
Department of Defense, Washington, D.C.  
Federal Register, Vol 41, No 17, p 8740, Jan 26, 1976. 1 p.

Descriptors: \*Texas, \*Flood control, \*Dams, \*Hydroelectric plants, \*Reservoirs, Federal government, Administrative agencies, Floods, Flood protection, Structures, Flow control, Water control, Hydroelectric power, Engineering structures, Electric power production, Water levels, Water utilization, Multiple-purpose projects, Gaging stations, Water storage, Reservoir storage, Energy.  
Identifiers: Energy conservation, Marshal Ford Reservoir, Administrative regulations, Colorado River(Tex).

The Corps of Engineers is proposing the revision of regulations for the use of flood control storage in the Marshall Ford Reservoir on the Colorado River in Texas and for the operation of the Marshall Ford Dam for flood control purposes. To better assess river conditions, stage reporting and coordination will be required from the Austin and Bastrop gaging stations in addition to the Columbia station. Minimum release rates from the project are specified so as to obtain more hydroelectric power benefit from the system without compromising its flood control capability. (Capehart-Florida)  
W77-04369

**BENZIDINE: PROPOSED TOXIC POLLUTANT EFFLUENT STANDARDS.**  
Environmental Protection Agency, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04370

**FLOOD CONTROL REGULATIONS.**  
Corps of Engineers, Washington, D.C.  
For primary bibliographic entry see Field 4A.  
W77-04371

**OCEAN DUMPING: PROPOSED REVISION OF REGULATIONS AND CRITERIA.**  
Environmental Protection Agency, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04372

**NAVIGABLE WATERS: DISCHARGE OF DREDGED OR FILL MATERIAL.**  
Environmental Protection Agency, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04373

**MINERAL MINING AND PROCESSING POINT SOURCE CATEGORY: APPLICATION OF EFFLUENT LIMITATIONS GUIDELINES FOR EXISTING SOURCES FOR PRETREATMENT STANDARDS FOR INCOMPATIBLE POLLUTANTS.**  
Environmental Protection Agency, Washington, D.C.

For primary bibliographic entry see Field 5G.  
W77-04374

**ENVIRONMENTAL PROTECTION AGENCY: PETROLEUM REFINING POINT SOURCE CATEGORY.**

Environmental Protection Agency, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04376

**ENVIRONMENTAL PROTECTION AGENCY: INORGANIC CHEMICALS MANUFACTURING POINT SOURCE CATEGORY.**

Environmental Protection Agency, Washington, D.C.  
For primary bibliographic entry see Field 5G.  
W77-04377

**STATE V AAMODT (RESERVED WATER RIGHTS OF PUEBLOS SUPERIOR TO STATE APPROPRIATION LAWS).**

537 F2d 1102-20 (10th Cir 1976). 19 p.

Descriptors: \*Pueblo water rights, \*Judicial decisions, \*New Mexico, \*Prior appropriation, \*Reservation doctrine, Water law, Legal aspects, Federal government, State governments, Federal reservations, Federal-state water rights conflicts, Water rights, Appropriation, Preferences(Water rights), Priorities, Unappropriated water, Indian reservations, River systems.  
Identifiers: Indians, Federal guardianship, Estoppel.

In accordance with its water adjudication statutes, the state of New Mexico brought suit for determination of its rights to the use of water of a certain river system. The state named all persons claiming water rights in this river system, including four Pueblo Indians as defendants. The United States intervened as guardian for the Pueblos. New Mexico and the private parties joined as defendants assert that the rights of the Pueblos are governed by the state law of prior appropriation. The United States and the Indians claim that the Indians have a reserved right prior to that of all non-Indians and an aboriginal right derived from the laws of Spain and Mexico and recognized by the United States in an 1858 treaty. The court upheld the reserved rights doctrine following prior cases which held that the federal government had the power to reserve waters and exempt them from appropriation and that such reservation is implied to the extent needed to accomplish the purposes of the reservation. Neither the 1924 nor the 1933 Pueblo Land Act can stop the Pueblos from claiming reserved water rights as they merely took what their guardian offered and released nothing. Furthermore, estoppel does not run against the United States acting in its capacity as a trustee. The language of the 1933 act recognizes in the Indians a prior right of the use of water for domestic, stockwater, and irrigation purposes unaffected by New Mexico appropriation laws. The court rejected balancing approach and held the water rights of Pueblos prior to all non-Indians whose land ownership was recognized pursuant to the 1924 and 1933 acts. (Moorhouse-Florida)  
W77-04378

**ASKEW V GAME AND FRESH WATER FISH COMMISSION (POLLUTION ABATEMENT EFFORTS HELD CONSTITUTIONAL).**  
336 So2d 556-60 (Fla 1976).

Descriptors: \*Florida, \*Fish, \*Constitutional law, \*Pollution abatement, Wildlife, Aquatic weeds, Aquatic plants, Weeds, Water hyacinth, Floating plants, State governments, Administrative agencies, Courts, Judicial decisions, Legal review, Legal aspects, Control, Governmental interrelations, Legislation, Water law, Fish and wildlife, Wildlife management, Permits.

Identifiers: \*White amur fish, Deer Point Lake(Florida), Florida Department of Natural Resources, Florida Game and Fresh Water Fish Commission, Licenses, Administrative regulations.

The Florida Department of Natural Resources introduced the White Amur fish into a fresh water lake for the purpose of controlling aquatic weeds. Three separate Florida statutes authorized such an action. The Florida Game and Fresh Water Fish Commission challenged the statutes on the basis of Article Four, Section 9 of the Florida Constitution which gives control over the state's animal and fish life to the Commission. The trial court agreed and declared the statutes unconstitutional. The Florida Supreme Court reversed on the basis of Article Two, Section 7 of the Florida Constitution which establishes the state's policy of conservation of natural resources and scenic beauty through abatement of air and water pollution. Declaring the statutes unconstitutional would strip the legislature of its power to carry out the abatement policy. The court concluded that, in construing the constitution, every section should be considered in the constitution to give the constitution effect as a harmonious whole. (Moorhouse-Florida)  
W77-04379

**APPROPRIATION AND USE OF WATER (PERMITS AND LICENSES; CONSTRUCTION OF WORKS).**

New Mexico Stat. Ann. secs 75-5-1 thru 75-5-37 (1968), as amended, (Supp. 1975).

Descriptors: \*New Mexico, \*Water management(Applied), \*Permits, \*Prior appropriation, \*Legislation, Water permits, Water policy, Water rights, Water law, Water transfer, Engineering structures, Measurement, Flow meters, Unappropriated water, Water sources, Water utilization, Irrigation ditches, Irrigation permits, Public rights, State governments, Water users, Water supply.

New Mexico has enacted legislation providing that the state engineer is to maintain close supervision over the construction of all works built for the purpose of making beneficial uses of waters. A construction permit is granted only after public notice and hearings regarding the essential facts of the intended appropriation. Maximum water allowances for irrigation purposes are based upon beneficial use in accordance with good agricultural practices. In addition, the state highway commission is allowed advance withdrawals in amounts equal to five times the annual amount actually held and may accrue unused water, subject to forfeiture of the accrued portion, upon the transfer of its water rights. Subject to exceptions, parties failing to make full or partial beneficial usage of their water allocation for four years forfeit unused portion if they fail to make beneficial use for one year after notice of possible forfeiture is given. Also, the state engineer must be advised of intended transfer of water rights. Ditch owners may be required to install devices to measure the amounts of water diverted. Records of water rights must be filed with the county clerk. Finally, decisions of the state engineer may be appealed to the district court of the county in which the appropriation point is situated. (Joseph-Florida)  
W77-04380

**WATER RESERVOIRS.**

Oklahoma Stat. Ann. tit 63, secs 1-912 thru 1-914 (1973).

Descriptors: \*Reservoirs, \*Reservoir, Ad-Domestic disposal disposal sources, Identifi

Oklahoma state board on property drainage reservoirs or Such reservoirs wastes, other water provisions within the junction (Capehart-Florida)  
W77-04381

**OKLAHOMA BOARD OF OKLA ST**  
Descriptors: \*Pollution, tracts, Rivers, Land territorial resources management

Oklahoma Planning means necessary Board's cities in cooperation with lands, the commission authorizes all surface through control lands a parks, (Capehart-Florida)  
W77-04382

**WATER ADMINISTRATION**  
Cal. W. 1971).

Descriptors: \*Water management, \*Water administration, \*Groundwater management(ing).

Section here in (2) use, municipal water, rights, provisions, tractions and of quantities, rights, provide water, tributaries, (W77-04383)

## WATER RESOURCES PLANNING—Field 6

### Nonstructural Alternatives—Group 6F

**Descriptors:** \*Oklahoma, \*Public health, \*Reservoirs, \*Environmental sanitation, Regulation, Administrative agencies, Drainage systems, Domestic wastes, Industrial wastes, Sewage disposal, Cities, Watersheds(Basins), Waste disposal, Garbage dumps, Water pollution sources, Legislation, Water quality, Mosquitoes. Identifiers: \*Malaria.

Oklahoma has enacted legislation authorizing the state board of health to regulate sanitation control on property within any reservoir or reservoir drainage basin except municipally-owned reservoirs or private reservoirs not open to public use. Such regulations shall include provisions for the collection and disposal of domestic and industrial wastes, prohibitions on the dumping of garbage or other wastes within any reservoirs or basin, and provisions for the disposal of all wastes originating within the reservoir or basin. Malaria control measures shall be taken for impounded waters in conjunction with the state department of health. (Capchart-Florida)  
W77-04381

#### OKLAHOMA PLANNING AND RESOURCES BOARD.

Okl Stat Ann tit 74, secs 351(b) thru 351(h) (1976).

**Descriptors:** \*Oklahoma, \*Recreation facilities, \*Pollution control, \*Administrative agencies, Contracts, Federal government, Streams, Lakes, Rivers, Sub-surface waters, Parks, Recreation, Land tenure, Real property, Surface waters, Natural resources, Cities, Land resources, Land management.

Oklahoma has enacted legislation empowering the Planning and Resources Board to acquire by any means and to maintain and operate any property necessary for the proper performance of the Board's function. The Board may cooperate with cities in the state and with the Board of Agriculture in any project. The Board is authorized to cooperate with the federal government and to provide to the federal government without cost, all lands, easements, and rights-of-way necessary for the construction of projects. The Board is also authorized to regulate and control the pollution of all surface and subsurface waters in and flowing through the state. The Board has administrative control over all state parks, lakes, and recreational lands and has the power to acquire land for state parks, monuments, or recreational purposes. (Capchart-Florida)  
W77-04382

#### WATER (GENERAL INTERPRETATION AND ADMINISTRATION PROVISIONS).

Cal. Water Code Ann. secs 1000 thru 1052 (West 1971).

**Descriptors:** \*California, \*Administrative agencies, \*Municipal water, \*Groundwater resources, \*Water allocation(Policy), Water transfer, Administrative decisions, Water supply development, Water, Resources development, Resources, Groundwater, Regulation, Water management(Applied), Groundwater availability, Pumping.

Sections of the California Water Code presented here in annotated form include: (1) title to water; (2) useful or beneficial purposes; (3) rights of municipal corporations to acquire and appropriate water; and (4) various aspects of groundwater rights and usage. This last is dealt with in several provisions covering cessation or reduction in extraction, replenishment by use of alternate supply, and effects of failure to pump or extract the full quantity of water to which an owner of water rights is entitled. Also annotated are sections providing for the investigative powers of the state water rights board, and for supervision of trial distribution of water by the board. (Josepher-Florida)  
W77-04383

#### PERMITS FOR USE OF PESTICIDES IN STATE WATERS.

Conn. Gen. Stat. Ann. sec 19-300u (Cum Supp 1976).

**Descriptors:** \*Connecticut, \*Legislation, \*Inorganic pesticides, \*Fungicides, \*Herbicides, \*Molluscicides, Larvicides, Agricultural chemicals, Inhibitors, Pest control, Plant growth regulators, Chemicals, Permits, Water pollution sources, Administrative agencies.

Connecticut has enacted legislation declaring that sodium fluoroacetate is an unlawful substance for sale, possession or use. Sale or possession by any person other than government officers and specially licensed operators with permission or use without special authority is punishable by fine. Introduction of any chemical into state waters without permit is prohibited. Any permittee introducing chemicals remains liable for any resulting damages. Enforcement is the duty of the state health department and environmental protection department. (Comer-Florida)  
W77-04384

#### OGLE V TERMINAL RAILROAD ASSOCIATION OF ST. LOUIS (FLOODING DAMAGES FROM RAILWAY'S INADEQUATE CULVERT OPENINGS).

534 Sw2d 809-13 (Mo Ct App 1976). 5 p.

**Descriptors:** \*Missouri, \*Culverts, \*Embankments, \*Rainfall-runoff relationships, \*Railroads, Flood damage, Damages, Legal aspects, Channels, Rainfall, Drains, Drainage, Water, Downstream, Outlets, Right-of-way, Flow, Floods, Judicial decisions, Alteration of flow, Water-courses(Legal aspects).

Plaintiff landowners sought damages for defendant railroad company's failure to comply with minimum statutory requirements pertaining to construction of suitable drainage openings in the railroad's roadbed. The defendant's railroad right-of-way crossed a short distance down river from the plaintiff's home. On numerous occasions after heavy rainfalls the water had backed up from the culvert and flooded plaintiffs' home causing damages. Plaintiffs' expert witness testified that in his opinion the water backed up because the culvert was too small to permit the flow of water through the embankment. The defendant contended that even if it enlarged the culvert it would not alleviate the flooding since the entire channel downstream was inadequate to carry off the water coming through the culvert; thus, defendant's duty was limited to passing only that water through the embankment which could be carried off by the watercourse below. The Missouri Court of Appeals held that the inadequacy of a watercourse does not excuse noncompliance with the statute. The court reversed the circuit court's judgement for the defendant and directed a new trial on all issues. (Rieck-Florida)  
W77-04385

#### WATER RIGHTS DETERMINATION AND ADMINISTRATION ACT OF 1969.

Colo. Rev. Stat. Ann. sec. 37-92-101 thru 37-92-602 (1973).

**Descriptors:** \*Colorado, \*State governments, \*Water resources, \*Groundwater resources, \*Appropriation, Groundwater, Legal aspects, Groundwater availability, Water allocation(Policy), Water policy, Wells, Aquifers, Aquifer management, Water law, Drilling. Identifiers: \*Water rights(Non-riparians).

Colorado has enacted legislation providing methods for appropriation of groundwater. Each diverter must establish some reasonable means of establishing diversion. Water divisions, with different division engineers for each, are established. One water judge in each division shall have exclu-

sive jurisdiction over all water matters. Provision is also made for appointment of water referees, and procedures for the administration and distribution of groundwater rights are described and enumerated. Both water judges and referees shall follow the detailed procedures of the article. Priority of dates shall establish the priority of water rights. Finally, the state engineer must publish all water rights ranked in priority. Exemptions include designated groundwater basins. (Frank-Florida)  
W77-04386

#### WHERE CALIFORNIA STANDS ON PLANNING FOR ITS COAST.

California Coastal Zone Conservation Commission, San Francisco.  
For primary bibliographic entry see Field 2L.  
W77-04463

#### COASTAL-ZONE PLANNING: AN INTEGRATED APPROACH,

Nassau-Suffolk Regional Planning Board, N.Y.  
For primary bibliographic entry see Field 2L.  
W77-04464

#### THE NORTH CAROLINA COASTAL AREA MANAGEMENT ACT — A PROGRAM OF STATE-LOCAL GOVERNMENT COOPERATIVE PLANNING IN THE COASTAL ZONE,

North Carolina Dept. of Natural and Economic Resources, Raleigh.  
For primary bibliographic entry see Field 2L.  
W77-04465

#### COASTAL ZONE LEGISLATION: LOUISIANA LANDMARKS, LABYRINTHS AND LOGROLLING,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.  
For primary bibliographic entry see Field 2L.  
W77-04466

#### 'ADJACENT STATES' RESPONSIBILITIES IN OUTER CONTINENTAL SHELF ACTIVITIES,

Virginia Energy Office, Richmond.  
For primary bibliographic entry see Field 5G.  
W77-04489

#### FLOOD INSURANCE: THE LEGAL TIDE RISES AGAIN.

Pennsylvania State Univ., University Park. Coll. of Business Administration.  
For primary bibliographic entry see Field 6F.  
W77-04563

#### ENFORCEMENT UNDER THE ILLINOIS POLLUTION LAW,

Chicago Univ. Law School, Ill.  
For primary bibliographic entry see Field 5G.  
W77-04567

### 6F. Nonstructural Alternatives

#### OPTIMIZATION MODEL FOR THE DESIGN OF URBAN FLOOD-CONTROL SYSTEMS,

Texas Univ. at Austin. Center for Research in Water Resources.

For primary bibliographic entry see Field 2E.  
W77-04179

#### THE NATIONAL FLOOD INSURANCE PROGRAM—A MODEL ORDINANCE FOR IMPLEMENTATION OF ITS LAND MANAGEMENT CRITERIA,

Florida Univ., Gainesville. School of Law.  
F. E. Maloney, and D. C. Damby.

## Field 6—WATER RESOURCES PLANNING

### Group 6F—Nonstructural Alternatives

Natural Resources Journal (University of New Mexico School of Law), Vol 16, p 665-736, July 1976. SG04-5-158-44.

Descriptors: \*Insurance, \*Flood damage, \*Legislation, \*Flood protection, \*Rivers and Harbors Act, Land use, Management, Disasters, Hazards, Hurricanes, Model studies, \*Land management.

Identifiers: \*Flood insurance, \*Land use management.

As background for a better understanding of the 1973 Act and the model ordinance, a history of the development of the National Flood Insurance Program is set forth in part one of this article. This is followed in part two by an analysis of the National Flood Insurance Program in its present form. Part three discusses the problem of whether regulation under the Flood Disaster Protection Act and implementing state and local legislation would constitute a 'taking' of regulated property in violation of state and federal constitutional provisions against such takings. Part four sets forth the model ordinance with commentary including citation of sources from which the various provisions of the model were developed. (NOAA)

W77-04186

CONNECTICUT RIVER BASIN, SUPPLEMENTAL STUDY, NEW HAMPSHIRE, VERMONT, MASS. AND CONN. THE RIVER'S REACH. PHASE II. LAND USE CHANGES IN SELECTED FLOOD PLAINS,  
Economic Research Service, Broomall, Pa.  
For primary bibliographic entry see Field 4A.

W77-04205

FLOOD PLAIN INFORMATION: MARICOPA COUNTY, ARIZONA, VOLUME III, SKUNK CREEK REPORT.  
Army Engineer District, Los Angeles, Calif.  
For primary bibliographic entry see Field 4A.  
W77-04210

FLOOD PLAIN INFORMATION: HOCKING RIVER, ATHENS, OHIO.  
Army Engineer District, Huntington, W. Va.  
For primary bibliographic entry see Field 4A.  
W77-04211

FLOOD PLAIN INFORMATION: LITTLE ARKANSAS RIVER AND BLACK KETTLE CREEK, HALSTEAD, KANSAS.  
Army Engineer District, Tulsa, Okla.  
For primary bibliographic entry see Field 4A.  
W77-04212

FLOOD PLAIN INFORMATION: NORTH PLATTE, NEBRASKA; NORTH PLATTE RIVER AND SOUTH PLATTE RIVER.  
Army Engineer District, Omaha, Nebr.  
For primary bibliographic entry see Field 4A.  
W77-04213

FLOOD PLAIN INFORMATION: SIOUX CITY, IOWA, VOLUME I, PERRY CREEK,  
Army Engineer District, Omaha, Nebr.  
For primary bibliographic entry see Field 4A.  
W77-04214

FLOOD PLAIN INFORMATION: STEAMBOAT CREEK AND TRIBUTARIES, STEAMBOAT AND PLEASANT VALLEYS, NEVADA.  
Army Engineer District, Sacramento, Calif.  
For primary bibliographic entry see Field 4A.  
W77-04215

FLOOD PLAIN INFORMATION: SAND AND COTTONWOOD CREEKS AND THE LOWER KAWeah RIVER, VISALIA, CALIFORNIA.  
Army Engineer District, Sacramento, Calif.  
For primary bibliographic entry see Field 4A.

W77-04216

SPECIAL FLOOD HAZARD INFORMATION REPORT: BETZ ROAD DITCH, CITY OF BELLEVUE, NEBRASKA.

Army Engineer District, Omaha, Nebr.  
For primary bibliographic entry see Field 4A.

W77-04217

SPECIAL FLOOD HAZARD INFORMATION REPORT: NORTH FORK BIG NEMaha RIVER AND TOWN BRANCH, TECUMSEH, NEBRASKA.

Army Engineer District, Kansas City, Kans.  
For primary bibliographic entry see Field 4A.

W77-04218

SPECIAL FLOOD HAZARD INFORMATION REPORT: SOUTH BRANCH WEST FORK BIG BLUE RIVER, HASTINGS, NEBRASKA.

Army Engineer District, Kansas City, Kans.  
For primary bibliographic entry see Field 4A.

W77-04219

SPECIAL FLOOD HAZARD INFORMATION REPORT: REPUBLICAN RIVER AND CROOKED CREEK, RED CLOUD, NEBRASKA.

Army Engineer District, Kansas City, Kans.  
For primary bibliographic entry see Field 4A.

W77-04220

THE FLOOD PLAIN ZONING EXPERIENCE IN THE GREAT LAKE STATES,

Florida Univ., Gainesville. School of Law.  
For primary bibliographic entry see Field 6E.

W77-04364

FLOOD CONTROL REGULATIONS.

Corps of Engineers, Washington, D.C.  
For primary bibliographic entry see Field 4A.

W77-04371

FLOOD INSURANCE: THE LEGAL TIDE RISES AGAIN.

Pennsylvania State Univ., University Park. Coll. of Business Administration.  
B. L. Myers.  
Center for the Study of Environmental Policy, Working Paper No. 24, January 1976. 12 p. 9 ref.

Descriptors: \*Legislation, \*Flood plain insurance, \*Flood plain zoning, \*Legal aspects, \*Land use, \*Non-structural alternatives, Riparian land, Flood protection, Watershed management, Zoning, Insurance, Institutional constraints, Local governments, Federal government, Governmental interrelations, Building codes.

Identifiers: \*National Flood Insurance, \*Flood Disaster Protection Act.

Two pieces of federal legislation aimed at providing insurance to protect against flood damages are reviewed in terms of their provisions and legal implications: the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Under the legislation, a property owner has no right to purchase flood insurance unless he can persuade his local government to meet initial land use and control requirements stipulated by the 1973 amendment. Moreover, he cannot continue to hold such insurance unless the local government enacts relatively strong regulations in the 100-year flood plain area. These and other legal implications, have provided impetus for numerous congressional bills aimed at modifying the stringent flood insurance regulations. It is recommended

that the coercive force of the 1973 amendments not be destroyed, but that they should be made more effective by banishing federal and related monies from entire communities that reject the control programs. If voters who were not necessarily residents of flood plains were to be adversely affected by the decisions made by their local governments, virtually all communities would adopt such regulations. This would make flood insurance available everywhere, with local government in charge and the federal government playing only an initial role. (Harris-Wisconsin)

W77-04563

### 6G. Ecologic Impact Of Water Development

POLLUTION ABATEMENT AND REGIONAL WELFARE: A CONTROL THEORY APPROACH,  
State Univ. of New York at Binghamton.  
M. Chatterji, and F. Moulaoert.  
Tijdschrift voor Economie en Management, Vol. 21, No. 2, p. 201-224, 1976. 1 tab., 12 ref.

Descriptors: \*Mathematical models, \*Pollution abatement, \*Regional development, Model studies, Optimum development plans, Equity, Regional economics, Social aspects, Input-output analysis, Industrial production, Demand.  
Identifiers: \*Control theory, Regional welfare.

Optimal control theory is applied to the question of how to compensate for pollution caused in one area by the production of inputs for consumption in another. A generalized model is developed to determine the amount of the final demand of national and regional goods, and the level of tolerance of pollution in each region such that the welfare of all the regions of the planning period is maximized subject to the technological path of the production variables, population growth and migration, and other restrictions. The model contains both abatement and relocation strategies for pollution control. Because it is an input-output model, it can take the productive and the ecological system through an infinite number of chain reactions, and it also integrates the demographic and employment variables. The policy variables suggested can be controlled directly and indirectly both in a free as well as in a socialist economy. Diffusion of pollution between regions was not taken into account, a multi-regional rather than a more realistic interregional framework is used, and the constancy of the input coefficients and the old primary input were assumed. Employing control theory makes the situation more realistic. (Luedtke-Wisconsin)

W77-04169

STATE OF OREGON COASTAL ZONE MANAGEMENT PROGRAM, DRAFT ENVIRONMENTAL IMPACT STATEMENT,  
National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management.  
February 27, 1976. 285 p, 6 fig, 10 tab, 7 ref.

Descriptors: \*Oregon, \*Resources development, \*Land use, \*Environmental effects, \*Baseline studies, \*Water pollution effects, \*Quality control, Water resources, Coasts, Beaches, Shores, Wetlands, Geomorphology, Climate, Economics.  
Identifiers: \*Coastal Zone management, \*Environmental impact.

This environmental impact statement presents descriptions of the Federal and Oregon coastal management programs along with descriptions of the environment affected. It examines the relationship of the proposed action to land use plans, policies and controls for the area and the probable impact on the environment. Alternatives are examined for assessment. Probable adverse environmental effects which cannot be avoided are set

## WATER RESOURCES PLANNING—Field 6

### Ecologic Impact Of Water Development—Group 6G

forth. Consideration is given to the relationship between local short-term uses and the maintenance and enhancement of long-term productivity. Irrevocable or irretrievable commitments of resources that would be involved are identified. (NOAA)  
W77-04184

#### PROPOSED FEDERAL APPROVAL OF THE COASTAL ZONE MANAGEMENT PROGRAM, MID-COAST SEGMENT, STATE OF MAINE, DRAFT ENVIRONMENTAL IMPACT STATEMENT.

National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management.

March 1975. 113 p, 6 fig, 4 tab, 9 ref, 4 append.

Descriptors: \*Maine, \*Resources development, \*Land use, \*Environmental effects, \*Baseline studies, \*Water pollution effects, \*Quality control, Water resources, Coasts, Beaches, Shores, Wetlands, Geomorphology, Climate, Economics. Identifiers: \*Coastal Zone management, \*Environmental impact.

This environmental impact statement presents descriptions of the Federal and Maine coastal management programs along with descriptions of the environmental affected. It examines the relationship of the proposed action to land use plans, policies and controls for the area and the probable impact on the environment. Alternatives are examined for assessment. Probable adverse environmental effects which cannot be avoided are set forth. Consideration is given to the relationship between local short-term uses and the maintenance and enhancement of long-term productivity. Irrevocable or irretrievable commitments of resources that would be involved are identified. (NOAA)  
W77-04185

#### BARATARIA BASIN: GEOLOGIC PROCESSES AND FRAMEWORK,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.

For primary bibliographic entry see Field 2L.

W77-04187

#### ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. VOLUME 1. PRINCIPAL INVESTIGATORS' REPORTS APRIL-JUNE 1976.

National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

September 1976, 962 p.

Descriptors: \*Alaska, \*Baseline studies, \*Resources development, \*Environmental effects, \*Continental Shelf, \*Marine biology, \*Aquatic life, Coasts, Marine fish, Plankton, Aquatic algae, Benthos. Identifiers: \*Outer Continental Shelf, \*Coastal zone, Marine birds.

This volume contains the quarterly reports of baseline studies on the environmental effects of the development of resources on the Alaska continental shelf. Baseline studies encompass the marine mammals, birds, fish, plankton, benthos and littoral biota. (NOAA)  
W77-04200

#### ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. VOLUME 2. PRINCIPAL INVESTIGATORS' REPORTS APRIL-JUNE 1976.

National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

September 1976, 898 p.

Descriptors: \*Alaska, \*Baseline studies, \*Environmental effects, \*Water pollution effects, \*Resources development, \*Pollution effects, \*Oil pollution, \*Oil spills, \*Toxicity, Ice, Data processing, Chemistry, Microbiology, Marine biology.

Identifiers: \*Outer continental shelf, Physical oceanography, Petroleum hydrocarbons, Trace metals.

This volume contains the quarterly reports of baseline studies on the environmental effects of the development of resources on the Alaska continental shelf. Baseline studies encompass pollution effects, chemistry and microbiology, physical oceanography geology, ice and data management. (NOAA)  
W77-04201

#### SYMPOSIUM, THE FUTURE OF CHESAPEAKE BAY.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 457, Price codes: A07 in paper copy, A01 in microfiche. Held at Arlington, Virginia, Thursday, April 15, 1976, American Water Resources Association, National Capital Section, Washington, D.C. (1976), 130 p. Sponsored by National Wildlife Federation and Wildlife Management Institute.

Descriptors: \*Chesapeake Bay, Ecology, \*Water pollution, Maryland, Virginia, \*Channel improvement, Ships, \*Ports, Navigation, \*Beach erosion, \*Wetlands, Ecosystems, \*Ecological distribution, Salinity, Sedimentation, Erosion control, \*Water quality, Oil spills, Oil pollution. Identifiers: \*Baltimore port area(Md).

Contents (technical articles): The Dynamics of Chesapeake Bay, by Donald W. Pritchard; Channelization and Shipping, by Robert S. Garry; Ports: Baltimore in Particular, by Walter C. Boyer; Shore Erosion and Wetlands, by Paul W. McKee; Pollution, by Eugene T. Jensen; and Ecology, by L. Eugene Cronin.  
W77-04203

#### PROCESS AND ENVIRONMENTAL TECHNOLOGY FOR PRODUCING SNG AND LIQUID FUELS,

For primary bibliographic entry see Field 3E.

W77-04204

#### WATER POLLUTION CONTROL ACT OF 1972, REGIONAL IMPACTS, MERRIMACK-NASHUA RIVER BASIN.

Abt Associates, Inc., Cambridge, Mass.

For primary bibliographic entry see Field 5G.

W77-04310

#### THE COAST: WHERE ENERGY MEETS THE ENVIRONMENT,

San Diego Univ., Calif. School of Law.

For primary bibliographic entry see Field 6E.

W77-04351

#### PROTECTION AND CONTROL OF THE SALT WATER SHORE AREA,

Rhode Island Statewide Planning Program, Providence.

For primary bibliographic entry see Field 6E.

W77-04361

#### POWER PLANT SITING: CAUGHT BETWEEN ENERGY CRISIS AND ENVIRONMENTAL CONCERN,

Florida Univ., Gainesville. School of Law.

For primary bibliographic entry see Field 6E.

W77-04363

**FACTORS AFFECTING FOREST PRODUCTION ON ORGANIC SOILS,**  
North Carolina State Univ., Raleigh. Dept. of Forestry.

For primary bibliographic entry see Field 4A.

W77-04387

#### THE PRESENT AND FUTURE OF COASTS.

Coastal Society, Bethesda, Md.

For primary bibliographic entry see Field 2L.

W77-04462

#### EXPLORATION AND PETROLEUM DEVELOPMENT OF THE U.S. OUTER CONTINENTAL SHELF: A MOVE TOWARD SELF-SUFFICIENCY,

H. R. Hirsch.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p 62-67.

Descriptors: Economics, \*Resources development, \*Natural gas, \*Oil industry, Natural resources, Water quality control, Planning, \*Exploration.

Identifiers: \*Outer Continental Shelf, \*Offshore exploration, \*Coastal zone management, \*Energy sources, Environmental protection.

'U.S. Offshore Oil: Plans, Policies, Problems' incorporates two of the most important issues of the 1970's: energy and environment. Not only are these issues important they are controversial, emotional and sometimes personal because they directly affect our life styles. On the environmental side, we want clear air, clean water, and unspoiled ground. On the energy side, we want adequate amounts of gasoline, fuel oil, natural gas, and the myriad of other products derived directly or indirectly from petroleum, and we want these things at low cost. In sort, we want the things that cheap energy can provide, like economic laws of supply and demand. The natural-gas industry is a prime example of how these various desires have combined to create serious problems for a large segment of the population. Rapid strides in offshore development have got to be made and the petroleum industry has the technical expertise to undertake that task immediately. The industry is ready, willing, and able to risk large sums of money in offshore exploration and development but the price structure must be such that sufficient capital is available to make the large investments required. (See also W77-04462) (Sinha-OEIS)

W77-04468

#### FLORIDA'S EXPERIENCE - THE WAY WE WERE - AND SHOULDN'T HAVE BEEN,

Florida Audubon Society, Maitland.

For primary bibliographic entry see Field 5G.

W77-04469

#### ECOLIBRIUM, A BALANCE BETWEEN ECONOMY AND ECOLOGY,

National Oceanic and Atmospheric Administration, Washington, D.C. Office of the Administrator.

A. Spilhaus.

In: The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society, held at Arlington, VA, November 1975. p 79-87.

Descriptors: Coasts, \*Ecology, \*Economy, Land use, \*Management, Resources development.

Identifiers: \*Coastal zone management.

The ends of coastal-zone management are to multiply the uses people have in this unique zone of the earth that we all love so much. That end is an excellent one, but let's not get carried away with public versus private ownership. Management of land can be carried out without raising this spector

## Field 6—WATER RESOURCES PLANNING

### Group 6G—Ecologic Impact Of Water Development

of ownership. As we have seen on certain parks and on certain islands, this is a sure way to destroy things. Again, the people in charge have a charter to make lands available to the public—a very good thing—and at the same time to conserve the same lands from the degradations of the public. This is a pretty neat balance of ownership and responsibility. You use certain parts of your land for people and protect other parts from them. People, after all, when they crowd together are in excess and a pollutant by definition is something which by its excess inhibits the quality of life. If we accept this by his very numbers he does indeed destroy or harm another man's living. (See also W77-04462) (Sinha-OEIS)  
W77-04470

**COASTAL ENVIRONMENTAL IMPACT ASSESSMENT: LESSONS FROM OIL SPILLS,**  
University of Southern California, Los Angeles.  
Allan Hancock Foundation.

D. Straughan.

In: *The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society*, held at Arlington, VA, November 1975. p 116-123.

Descriptors: \*Oil spills, \*Baseline studies, \*Environmental effects, Coasts, Resources development.

Identifiers: \*Outer Continental Shelf, Environmental assessment.

The problems of environmental assessment are initially discussed on a broad scale to illustrate the need for a multidisciplinary approach. The emphasis then shifts to the marine science aspect of the problem. Based on experience in assessing the aftermath of oil spills and establishing so-called 'baselines', a problem oriented cause and effect is proposed. This should provide data to be used in a predictive capacity for future assessments. (See also W77-04462) (Sinha-OEIS)  
W77-04472

**FARMERS AND FISHERMEN: INTERACTION IN THE COASTAL ZONE,**  
Maryland Univ., College Park Cooperative Extension Service.

D. G. Pitt, B. Sorter, and W. J. Bellows.

In: *The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society*, held at Arlington, VA, November 1975. p 128-144, 14 ref.

Descriptors: \*Water pollution sources, \*Water quality control, \*Resources development, Water resources, Coasts, Farm management, Land use, Public health, Fisheries, Regulation.  
Identifiers: Coastal zone management.

The effects of the interactions that occur between farmers and fishermen in the coastal zone is examined. Data for this study were obtained by analyzing many of the limited number of the secondary source documents that exist. In addition, about 77 interviews were conducted with farmers, fishermen, and state and county agency personnel. In examining these interactions this paper focuses on: (1) the direct and indirect effects of interactions between farmers and fishermen, (2) effects of farmers on fishermen, (3) effects of fishermen on farmers, (4) characteristics of fishermen, and (5) effects of fishermen on fishermen. The results of the study indicate that: Farmers and fishermen have little direct effect on each other. There is a negligible amount of conflict between farmers and fishermen. Fishermen may be indirectly affected by agricultural non-point source pollution. Farmers may be adversely affected by government imposed water quality regulations designed, in part, to benefit fishermen. Fishermen tend to have unique personality traits that result in a rather short-term perspective concerning their occupational interactions. Competition for the Bay area as a natural resource by various user groups

may result in future adverse effects on the Bay as a food resource. (See also W77-04462) (Sinha-OEIS)  
W77-04473

#### PEOPLE AND THE SEA: FUTURE IMPACTS AND OPPORTUNITIES,

Delaware Univ., Lewes. Coll. of Marine Studies; and Delaware Univ., Newark. Marine Studies Complex.

W. S. Gaither.

In: *The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society*, held at Arlington, VA, November 1975. p. 145-154.

Descriptors: \*Resources development, Water resources, \*Environmental effects, Coasts, Governments, Management, Continental Shelf.

Identifiers: \*Outer Continental Shelf, \*Environmental impact, \*Offshore exploitation, Coastal zone management.

The types of activities now taking place in the coastal zone, on the continental shelf, and in the ocean are reviewed and predictions of other activities that will occur before the year 2000 are made. Five alternative methods to manage offshore resources in a unified way are described and discussed. Strong leadership is urged at the national level to establish a suitable overall management structure to handle offshore resources. (See also W77-04462) (Sinha-OEIS)  
W77-04474

#### THERMAL POLLUTION IN THE LOS ANGELES-LONG BEACH HARBOR: CONSEQUENCES AND ALTERNATIVES,

University of Southern California, Los Angeles.  
Allan Hancock Foundation.

For primary bibliographic entry see Field 5B.

W77-04476

#### THE WETLANDS DILEMMA: A SOLUTION,

New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.

J. E. Carroll.

In: *The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society*, held at Arlington, VA, November, 1975. p. 177-181.

Descriptors: \*Wetlands, \*Estuaries, \*Conservation, Water resources, \*Environmental control, Coasts, Marsh management.

Identifiers: Coastal zone management, Resources management, Private ownership, Subsidies.

If we are dealing with social values collectively accrued from privately or individually owned property, then perhaps we should remedy this injustice and preserve the wetlands by the use of a new social valuation approach, and institutionalize this approach under some type of 'soil bank' style plan or estuarine conservation district type of system similar in philosophy and thrust to the highly successful Soil Conservation District system in effect for our farmlands. It is perhaps about time that society, being the recipient of the value, pay the marshland owner to sacrifice his right to earn a profit by destroying or otherwise altering the integrity of the marsh. To accomplish this task the author proposes: a qualified institution first designate and map those marshes which are in a relatively natural ecologically healthy state; the owners of the mapped marshes would be determined and they would then be subsidized for keeping the wetland in its natural state; and the subsidy could take one of several forms such as reduction in property tax, cancellation of property tax, or a direct cash subsidy. (See also W77-04462) (Sinha-OEIS)  
W77-04477

**IN INTENSIVE BIOMETRIC INTERTIDAL SURVEY (PROJECT IBIS). A SALT MARSH MONITORING STUDY,**  
American Univ., Washington, D.C. Marine Science Program.

For primary bibliographic entry see Field 2L.  
W77-04478

#### THE ROLE OF PUBLIC PARTICIPATION IN COASTAL ZONE MANAGEMENT: AN ASSESSMENT OF THE ATTITUDES OF RELEVANT INTEREST GROUP LEADERS TOWARDS CZM '72,

Texas A and M Univ., College Station. Dept. of Political Science.

For primary bibliographic entry see Field 6B.  
W77-04479

#### COASTAL LANDFORMS AND SCENIC ANALYSIS: A REVIEW,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

For primary bibliographic entry see Field 6B.

W77-04480

#### FOCUSING ON VISUAL QUALITY OF THE COASTAL ZONE,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

For primary bibliographic entry see Field 6B.

W77-04481

#### ONSHORE POLICY RESEARCH AND OFFSHORE OIL: A BRITISH PERSPECTIVE,

Cook Coll., New Brunswick, N. J. Environmental Resources.

J. K. Mitchell.

In: *The Present and Future of Coasts, Proceedings of the First Annual Conference of the Coastal Society*, held at Arlington, VA, November 1975. p. 241-246, 16 ref.

Descriptors: \*Quality control, \*Resources development, \*Oil industry, \*Environmental effects, \*Baseline studies, United States, Coasts, Social values, Economics.

Identifiers: \*Outer Continental Shelf, \*Coastal zone management, Scotland, Offshore technology.

There are wide differences between the socio-economic and governmental structures of Scotland and the United States. Nevertheless, it is certain that many of the Scottish research topics would be equally valid subjects for investigation on this side of the Atlantic Ocean. If oil exists off the east coast, initial discoveries will probably be made within the next 2 to 3 years, and the first producing wells will be in operation before 1980. We now need to know what alternative patterns of onshore social and physical impact are likely to be under different sets of assumptions about location of wells, levels of production, onshore regulatory controls, public opinion and other factors. Without adequate data on existing socio-economic conditions; likely patterns of human responses to the prospect of an oil industry; and recognized public strategies for coping with onshore impacts, the potential benefits of this new-found resource are apt to be outweighed by its deleterious consequences for an unprepared society. (See also W77-04462) (Sinha-OEIS)  
W77-04484

#### ASSESSING THE VISUAL QUALITY OF THE COASTAL ZONE,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.

For primary bibliographic entry see Field 6B.

W77-04485

## WATER RESOURCES PLANNING—Field 6

### Ecologic Impact Of Water Development—Group 6G

**EDUCATION IN LAND USE DECISION MAKING,**  
E-P Education Services, Hamden, Conn.  
For primary bibliographic entry see Field 6B.  
W77-04486

**COMMENTS ON FOOD AND ENERGY RESOURCES IN THE COASTAL ZONE,**  
Federal Power Commission, Washington, D.C.  
Office of Energy Systems.  
For primary bibliographic entry see Field 2L.  
W77-04487

**ADVANCING TO THE REAR: A STRATEGY OF COASTAL ZONE MANAGEMENT ON ERODING SHORELINES (PRELIMINARY DISCUSSION),**  
For primary bibliographic entry see Field 2L.  
W77-04488

**'ADJACENT STATES' RESPONSIBILITIES IN OUTER CONTINENTAL SHELF ACTIVITIES,**  
Virginia Energy Office, Richmond.  
For primary bibliographic entry see Field 5G.  
W77-04489

**A RISK AND COST ANALYSIS OF TRANSPORTING SOUTHERN CALIFORNIA OUTER CONTINENTAL SHELF OIL.**  
Booz-Allen and Hamilton Inc., Bethesda, Md.  
For primary bibliographic entry see Field 5G.  
W77-04490

**ECOLOGICAL MODELING IN A RESOURCE MANAGEMENT FRAMEWORK,**  
Resources for the Future, Inc., Washington, D.C.  
The Proceedings of a Symposium sponsored by the National Oceanic and Atmospheric Administration and Resources for the Future. Published by Resources for the Future, Inc., Washington, D.C., July 1975. RFF Working Paper QE-1, 394 p, 212 ref. C. S. Russell, Ed. \$6.00.

Descriptors: \*Water quality control, \*Water resources, \*Management, \*Simulation analysis, \*Model studies, \*Ecology, \*Aquatic environment, \*Ecosystems, \*Environmental control, Lakes, Rivers, Phytoplankton, Pollutants, Fisheries, Effects, Hydrology, Social aspects, Equations, Decision making, Systems analysis.  
Identifiers: \*Ecological models, Interdisciplinary modeling.

This volume and the symposium on which it is based grew out of Resources for the Future's informal involvement as a consultant to the Marine Ecosystem Analysis (MESA) program management within the National Oceanic and Atmospheric Agency. It was proposed that an examination of the state-of-the-art in aquatic ecological modeling in a resource management context would be useful for the MESA staff, and this volume is the result of such a study. The book is introduced by a paper reviewing the development of water quality and ecological system models and their use for resource management purposes; a conceptual framework for analyzing regional environmental quality management problems is presented along with simulation and optimization approaches that could be used for ranking alternative strategies. This is followed by papers containing the following simulation studies: (1) CLEANER, the Lake George Model; (2) CLEAN, the aquatic model of the Eastern Deciduous Forest Biome; (3) the Delaware Estuary; (4) mathematical models of the North Sea; (5) phytoplankton models and eutrophication problems; (6) fish population models; (7) fisheries and ecological models in fisheries resource management; and (8) the management of large-scale environmental modeling projects. Finally, the volume is concluded with a paper which summarizes the symposium; considered are present problems and future prospects

of ecological modeling. Specific recommendations for ecosystem modeling in a resource management context are given, and an edited discussion transcript is presented. See W77-04503 (bb(Bell-Cornell))  
W77-04493

**ECOLOGICAL MODELING IN A RESOURCE MANAGEMENT FRAMEWORK: AN INTRODUCTION,**  
Resources For the Future, Inc., Washington, D.C.  
Quality of the Environment Program.  
W. O. Spofford, Jr.

In: Ecological Modeling in a Resource Management Framework (Ed. by Clifford S. Russell), p 13-48, Resources for the Future, Inc., Washington, D.C., July 1975. 3 fig, 30 ref.

Descriptors: \*Water resources, \*Water quality control, \*Ecology, \*Management, Linear programming, Optimization, Simulation analysis, Regional analysis, Algorithms, Economics, Equations, Systems analysis, Environmental control.  
Identifiers: \*Ecological models, Residual, Non-linear programming, Public policy, Equilibrium approach.

The problem of resource management requires intervention by public decision making bodies. The history of the development of water quality and ecological system models is sketched and the use of such models for purposes of resource management is described in general terms. A distinction is made between environmental models and management models. Presented is a conceptual framework for analyzing regional environmental quality management problems. Simulation and optimization approaches that could be used for ranking alternative management strategies are discussed. Considered is the use of optimization models for selecting management strategies yielding the maximum economic benefit. It is shown how nonlinear ecosystem models can be included with these management models using the 'environmental response matrix.' The discussion is based upon deterministic analyses of both economic and environmental systems and employs the equilibrium approach to the analysis of ecosystems. (See also W77-04493) (Bell-Cornell)  
W77-04494

**CLEANER: THE LAKE GEORGE MODEL,**  
Rensselaer Polytechnic Inst., Troy, N.Y. Fresh Water Inst.

R. A. Park, D. Scavia, and N. L. Clesceri.  
In: Ecological Modeling in a Resource Management Framework (Ed. by Clifford S. Russell), p 49-81, Resources for the Future, Inc., Washington, D.C., July 1975. 13 fig, 23 ref.

Descriptors: \*Model studies, \*Ecosystems, \*Environment, \*Management, \*Lakes, \*Simulation analysis, \*Water quality, Biology, Effects, Phytoplankton, Food chains, Zooplankton, Systems analysis, \*New York.  
Identifiers: \*Lake George(NY), Transferability, Environmental impact.

CLEANER, an ecosystem model based on the International Biological Program model CLEAN, has a number of characteristics useful to environmental management. It represents functional physiologic and ecologic relationships for major compartments of the ecosystem, with disaggregation of trophic levels appropriate for studying competition among dissimilar forms. It exhibits good calibration and has few data requirements, facilitating transferability. It is programmed for use in interactive mode from remote terminals, with user-oriented output—including transformation of biomass values to turbidity, scum, and taste and odor indicators. It is currently implemented as a one-dimensional model without physical mixing terms, but it can be coupled with existing hydrodynamic models. As a research tool, CLEANER can be used to test hypotheses con-

cerning complex ecosystem linkages and to guide data collection. As a management tool, it can be used to provide scenarios and to extract bivariate relationships between pollutants and ecosystem effects. The model can be utilized by citizen groups as an educational tool, by advisory groups as a means of examining environmental trade-offs, and by regulatory agencies as a means of determining sensitivities and evaluating environmental impacts. CLEANER will eventually be coupled with adjoint models that predict nutrient loadings and tourist response, permitting simulation of long-range environmental, social and economic impacts. CLEANER presently consists of the 14 equations in CLEAN specific to the pelagic portions of lakes. (See also W77-04493) (Bell-Cornell)  
W77-04495

**A DISCUSSION OF CLEAN, THE AQUATIC MODEL OF THE EASTERN DECIDUOUS FOREST BIOME,**  
Tetra Tech, Inc., Lafayette, Calif.

C. W. Chen.

In: Ecological Modeling in a Resource Management Framework (Ed. by Clifford S. Russell), p 83-101, Resources for the Future, Inc., Washington, D.C., July 1975. 5 fig, 17 ref.

Descriptors: \*Aquatic environment, \*Model studies, \*Lakes, \*Ecosystems, \*Computer models, Forests, Biomes, Research, Evaluation, Management, Watersheds(Basins), Lake Michigan, Estuaries, Systems analysis, Wastes, \*Water quality control, \*Simulation analysis.

Identifiers: Physical processes, Biological processes, Chemical processes, Data problems, Sensitivity analysis.

The paper discussed described a mathematical model CLEAN, a computer code name for the Comprehensive Lake Ecosystem Analyzer. Detailed mathematical formulations of the model were presented elsewhere (Bloomfield, et al, 1973, Park, et al, 1974). In the paper, general discussions were given of the model's functionality, parameters included, spatial representation, transferability, capability for input perturbation, and output. Also mentioned was how the model could be used in conjunction with a watershed model for the performance of population and waste load computations. The model was claimed useful both as a tool for ecosystem research and as an evaluation methodology for environmental management of a lake. The capability for interaction between users and the computer model was emphasized. Herein, comments are made regarding the model methodology, spatial representation, adaptation problems of a general model, data problems of a new application, and sensitivity analysis. An example is used in each case to illustrate the point being made. CLEAN, as the authors have claimed, does have a detailed representation for the complex biological system through the higher trophic levels. It is realistic for lakes where vertical stratification of temperature and plant nutrients are not severe. (See also W77-04493) (Bell-Cornell)  
W77-04496

**THE DELAWARE ESTUARY,**  
Resources for the Future, Inc., Washington, D.C.  
R. A. Kelly.

In: Ecological Modeling in a Resource Management Framework (Ed. by Clifford S. Russell), p 103-134, Resources for the Future, Inc., Washington, D.C., July 1975. 6 fig, 26 ref.

Descriptors: \*Delaware River, \*Estuaries, \*Ecology, \*Environment, \*Management, \*Water quality control, \*Simulation analysis, Regional analysis, Tides, Hydrology, Downstream, Advection, Streamflow, Pollutants, Standards, Mathematical models, Systems analysis.

Identifiers: Biological processes, Residuals management model.

## Field 6—WATER RESOURCES PLANNING

### Group 6G—Ecologic Impact Of Water Development

Although the level of understanding of ecological systems is still very low, many general principles and empirical observations of various systems allow construction of relatively realistic simulators of the natural world. The incorporation of these simulators into a specific management framework then allows analysis of various management alternatives to achieve desired objectives. This paper is concerned with the development of an ecological model which attempts to integrate several different aspects of water quality into a single framework in order to be able to quantify the relative contribution of discharges of various pollutants at selected points to violations of water quality standards wherever they occur. Described is the Delaware Estuary Model to be imbedded in the regional environmental quality management model developed at Resources for the Future. It is an 11-compartment ecological model for each of 22 reaches of the Delaware Estuary. The complex tidal hydrology is reduced to simple net downstream advection; shown also are results calculated with upstream dispersion taken into account. The tradeoffs between reducing the discharges of all materials and reducing only the discharges of materials which are contributing to standards violations can be explicitly evaluated. (See also W77-04493) (Bell-Cornell) W77-04497

#### APPLICATION OF MATHEMATICAL MODELS TO THE STUDY, MONITORING AND MANAGEMENT OF THE NORTH SEA, Liege Univ. (Belgium).

J. C. J. Nihoul.

In: Ecological Modeling in a Resource Management Framework (Ed. by Clifford S. Russell), p 135-147, Resources for the Future, Inc., Washington, D.C., July 1975. 5 fig, 4 ref.

Descriptors: \*Environmental control, \*Water pollution control, \*Mathematical models, \*Simulation analysis, \*Management, Pollutants, Ecology, Rivers, Decision making, Discharge(Water), Systems analysis, Forecasting.

Identifiers: \*North Sea, Ocean outfalls, Tidal model, Surge model.

Mathematical models of the North Sea have been developed in most of the bordering countries. The development of computing facilities allowing more ambitious programs has facilitated the combining of physical, biological, and chemical processes in a common, general, interdisciplinary model with the purpose of understanding the North Sea environment, predicting its evolution, and assisting in its management. Herein, models of the North Sea are briefly reviewed, including a tidal model and a storm surge model. Discussed is procession from a general mathematical description to a tractable mathematical model and later to more limited submodels. Finally, the Southern Bight Model is considered, which can predict the dispersion pattern of pollutants both in the water column and in the sediments. By evaluating the extent of the damage produced by a given coastal or offshore release, the model can thus appreciate the opportunity of authorizing or penalizing dumpings in the sea and assist management decision making. Hydrodynamicists and chemists have had a great deal to say about the project from the beginning, since, for example, the submodel of the currents in the bight is a highly complicated work in itself. (See also W77-04493) (Bell-Cornell) W77-04498

#### PHYTOPLANKTON MODELS AND EUTROPHICATION PROBLEMS, Manhattan Coll., Bronx, N.Y. Environmental Engineering and Science Program. For primary bibliographic entry see Field 5C. W77-04499

#### FISH POPULATION MODELS: POTENTIAL AND ACTUAL LINKS TO ECOLOGICAL MODELS, National Marine Fisheries Service, Beaufort, N.C. Atlantic Estuarine Fisheries Center. W. E. Schaaf.

In: Ecological Modeling in a Resource Management Framework, (Ed. by Clifford S. Russell), p 211-239, Resources for the Future, Inc., Washington, D.C., July 1975. 5 fig, 52 ref.

Descriptors: \*Fisheries, \*Fish populations, \*Ecology, \*Mathematical models, \*Water pollution control, \*Water quality, \*Ecosystems, Aquatic environment, Effects, Environmental control, Systems analysis.

Identifiers: Residuals.

Fish population dynamics models, characterized as predator-prey volterra systems, are considered a subset of more general compartmental ecosystem models. Both types of models are homogeneous, in the sense that their parameters do not reflect environmental variability; they are equilibrium centered and, therefore, have limited usefulness for predicting the effects of perturbations. Fishery models are shown to aid ecological modeling by (1) scaling the system (i.e., providing a minimum rate of output from a food web), and by (2) helping to specify the functional nature of feeding links, which may be the source of ecosystem stability or instability. Ecological theory and the development of general models will have an impact on fishery population dynamics models through a realization of a more holistic view, that the dynamic behavior of components (e.g., a fishery) is determined largely by the structure of the ecosystem and may be relatively insensitive to the parameters used in the component model. Both fishery biologists and systems ecologists need to develop a broader view that considers alternate steady states. Existing ecosystem models are not reliable as predictors of fish populations and existing fisheries models are not tailored to handle pollution problems; the need exists for better linkage. (See also W77-04493) (Bell-Cornell) W77-04500

#### FISHERIES AND ECOLOGICAL MODELS IN FISHERIES RESOURCE MANAGEMENT, Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Fisheries and Wildlife Sciences. R. T. Lackey.

In: Ecological Modeling in a Resource Management Framework, (Ed. by Clifford S. Russell), p 241-249, Resources for the Future, Inc., Washington, D.C., July 1975. 2 fig, 8 ref.

Descriptors: \*Fisheries, \*Model studies, \*Ecology, \*Ecosystems, \*Resources, \*Management, Decision making, Economics, Habitats, Computer models, Mathematical models, Benefits, Systems analysis.

Identifiers: Biological models, Social models.

Freshwater fisheries scientists have nearly always been more concerned with aquatic habitat and the whole array of aquatic animal and plant populations than their marine counterparts. Freshwater systems may often be manipulated as part of a management strategy. Although most scientists have been concerned with target fish populations, an important fisheries component—man—has been neglected in systems studies. The purpose of this article is to place fisheries and ecological models into a renewable natural resource management context. A fishery is defined as a system composed of habitat, aquatic animal and plant population (biota), and man. Management is the analysis and implementation of decisions to meet human goals and objectives through use of the aquatic resource. A model is defined as an abstraction of a system. A distinction is made between modeling and mathematical modeling; renewable natural resources modeling nowadays usually connotes modeling of a mathematical nature. Considered

herein are model interrelationships, including habitat, biological, social, supply-demand, ecosystem, and bio-economic models as components of fisheries models. Discussed also are potential modeling benefits and models and decision making. The author foresees a much closer involvement between 'modelers' and 'decision makers.' (See also W77-04493) (Bell-Cornell) W77-04501

#### MANAGEMENT OF LARGE-SCALE ENVIRONMENTAL MODELING PROJECTS, Oak Ridge National Labs., Tenn. R. V. O'Neill.

In: Ecological Modeling in a Resource Management Framework (Ed. by Clifford S. Russell), p 251-282, Resources for the Future, Inc., Washington, D.C., July 1975. 45 ref.

Descriptors: \*Environment, \*Systems analysis, \*Projects, \*Management, \*Research, Simulation analysis, Forests, Biomes, Ecosystems, Mathematical models.

Identifiers: \*Modelers, Interdisciplinary modeling.

Large-scale interdisciplinary systems analysis programs are relatively new to the environmental sciences. Management of any scientific research program is complex, but integrated research directed toward specific objectives adds new dimensions to the problem. Additional technical difficulties arise when simulation models play a key role in project integration and synthesis. This paper addresses a single aspect of the total problem management of the modeling component of the program. Specific emphasis is placed on the models, the modelers, and the interactions between systems analysis and other aspects of the program. The analysis is based upon the Eastern Deciduous Forest Biome (The International Biological Program). Discussed are the nature of a model and the attendant problems. Considered are the motivations and conflicts of the modeler, suggesting criteria for the management structure. In addition to managing the modelers themselves, project leadership must address questions concerning the interactions between modelers and other scientists in the program. (See also W77-04493) (Bell-Cornell) W77-04502

#### PRESENT PROBLEMS AND FUTURE PROSPECTS OF ECOLOGICAL MODELING, Resource Management Associates, Lafayette, Calif.

G. T. Orlob.

In: Ecological Modeling in a Resource Management Framework (Ed. by Clifford S. Russell), p 283-312, Resources for the Future, Inc., Washington, D.C., July 1975. 2 fig, 5 ref.

Descriptors: \*Resources, \*Management, \*Ecology, \*Mathematical models, \*Water quality control, \*Aquatic environment, \*Ecosystems, Decision making, Simulation analysis, Economics, Planning, Environmental control, Hydrodynamics, Hydrology, Evaluation, Reliability, Systems analysis, Forecasting.

Identifiers: Interdisciplinary modeling, Model development.

In outlining and analyzing present problems and future prospects for ecological modeling, this paper summarizes the proceedings entitled 'Ecological Modeling in a Resource Framework,' and therefore deals with a broad spectrum of topics. First, the management context is discussed in general terms. Next, the confusion between who are modelers and who are decision makers is dealt with, a problem which seemed particularly to trouble the participants. Discussed is the process of model development; six stages are identified: conceptualization, functional representation, computational representation, calibration, verification, and documentation. All these steps are seen as prior to application, the presumed goal. Next, an

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### Evaluation, Processing and Publication—Group 7C

assessment of the present status of ecological modeling is given. The situation is discussed with respect to: data; hydrodynamics, hydrology and the ecosystem; ecological concepts; aquaculture; acute vs. chronic effects; prediction, evaluation and reliability; adaptability and transferability; and bacteria. Finally, specific recommendations are made for the future role of ecological modeling in resource management. Existing ecological models should be calibrated, verified and applied to real situations to gain experience and understanding of the models' capabilities and limitations. (See also W77-04493) (Bell-Cornell)  
W77-04503

#### ENVIRONMENTAL TOXICITY OF AQUATIC RADIONUCLIDES: MODELS AND MECHANISMS.

Rochester Univ., N.Y.  
For primary bibliographic entry see Field 5C.  
W77-04508

#### THE LIMITS OF COST-BENEFIT ANALYSIS AS A GUIDE TO ENVIRONMENTAL POLICY.

Leicester Univ. (England).  
For primary bibliographic entry see Field 5G.  
W77-04561

#### MIDDLE FORK BAYOU D'ARBORNE RESERVOIR PROJECT, CLAIBORNE PARISH, LOUISIANA: A FEASIBILITY AND SOCIAL IMPACT STUDY.

Louisiana State Univ., Baton Rouge. Center for Agricultural Sciences and Rural Development.  
For primary bibliographic entry see Field 6B.  
W77-04562

## 7. RESOURCES DATA

### 7A. Network Design

#### GATE CONVECTION SUBPROGRAM DATA CENTER: SHIPBOARD PRECIPITATION DATA,

National Oceanic and Atmospheric Administration, Washington, D.C. Center for Experiment Design and Data Analysis.  
For primary bibliographic entry see Field 2B.  
W77-04196

#### IDENTIFICATION CODES FOR ORGANIZATIONS LISTED IN COMPUTERIZED DATA SYSTEMS OF THE U.S. GEOLOGICAL SURVEY.

Geological Survey, Reston, Va. Water Resources Div.  
M. D. Edwards, and M. O. Drilleau.  
Open-file report 76-855, 1976. 58 p, 1 fig, 2 ref.

Descriptors: \*Data storage and retrieval, \*Information exchange, \*Hydrologic data, \*Organizations, Federal government, State governments.

Identifiers: \*Organization codes, \*National Water Data Exchange(NAWDEX), Public organizations, Private organizations.

This report contains codes for the identification of public and private organizations listed in computerized data systems. These codes are used by the U.S. Geological Survey's National Water Data Exchange (NAWDEX), National Water Data Storage and Retrieval System (WATSTORE), and National Cartographic Information Center (NCIC). The format structure of the codes is discussed and instructions are given for requesting new codes. (Woodard-USGS)  
W77-04224

**DIRECTORY OF LOCAL ASSISTANCE CENTERS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),**  
Geological Survey, Reston, Va. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04225

**STATUS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX)—SEPTEMBER 1976,**  
Geological Survey, Reston, Va. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W77-04237

### 7B. Data Acquisition

**RIVER BASIN SNOW MAPPING AT THE NATIONAL ENVIRONMENTAL SATELLITE SERVICE,**  
National Environmental Satellite Service, Washington, D.C.  
For primary bibliographic entry see Field 2C.  
W77-04199

**ARIZONA LAND USE EXPERIMENT,**  
Arizona Resources Information System, Phoenix. C. C. Winikka, and H. H. Schumann.  
In: NASA Earth Resources Survey Symposium, Vol I-C, Technical Session Presentations, Land Use--Marine Resources, Houston, Texas, June 1975: National Aeronautics and Space Administration Rept NASA TM X-58168, p 1553-1572, 1975. 3 fig, 2 tab, 4 ref.

Descriptors: \*Remote sensing, \*Aerial photography, \*Photogrammetry, \*Satellites(Artificial), \*Arizona, Mapping, Water resources, Land use, Geology, Hydrology, Highways, Vegetation, Planning, Water resources development, Land development.

The Arizona Land Use Experiment is a major experiment being conducted jointly by the State of Arizona, the National Aeronautics and Space Administration (NASA), and the U.S. Department of the Interior. Statewide cartographic applications of remote sensor data taken by NASA high-altitude aircraft include the development of a statewide semi-analytic control network and the production of nearly 1900 orthophotoquads (image maps). Applications of the imagery, image maps, and derived information are being made in conjunction with soils and geologic mapping projects, water resources investigations, land use inventories, environmental impact studies, highway route locations and mapping, vegetation cover mapping, wildlife habitat studies, power plant siting studies, for statewide delineation of irrigation cropland, for position determination of drilling sites, as pictorial geographic bases for thematic mapping, as court exhibits, and as a ready reference to any or all areas of Arizona. (Woodard-USGS)  
W77-04245

**INSTRUMENTATION FOR FIELD STUDIES OF URBAN RUNOFF,**  
Canada Centre for Inland Waters, Burlington (Ontario).  
For primary bibliographic entry see Field 2E.  
W77-04246

**SNOW AND ICE SURFACES MEASURED BY THE NIMBUS 5 MICROWAVE SPECTROMETER,**  
Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.  
For primary bibliographic entry see Field 2C.  
W77-04270

**EUSTATIC SEA VARIATION IN THE LAST 2000 YEARS IN THE MEDITERRANEAN,**  
Bologna Univ. (Italy). Istituto di Fisica.  
For primary bibliographic entry see Field 2L.  
W77-04271

**ADJUSTMENT OF MEASURED PRECIPITATION FOR GAGE UNDERCATCH,**  
State Univ. of New York Coll. at Geneseo. Dept. of Geography.  
For primary bibliographic entry see Field 2B.  
W77-04274

**A LIGHT IN THE WATER.**  
For primary bibliographic entry see Field 8G.  
W77-04282

**BIOASSAY AND REMOTE SENSING OF AQUATIC MACROPHYTES IN THE PAMLICO RIVER ESTUARY,**  
East Carolina Univ., Greenville. Dept. of Biology.  
For primary bibliographic entry see Field 5C.  
W77-04325

**OCEANOGRAPHIC COMMISSION,**  
Oceanographic Commission of Washington, Olympia.  
For primary bibliographic entry see Field 6E.  
W77-04359

**EQUIPMENT AND TECHNIQUES FOR MONITORING THE VERTICAL DISTRIBUTION OF FISH IN SHALLOW WATER,**  
National Marine Fisheries Service, Seattle, Wash. Marine, Fish and Shellfish Div.  
For primary bibliographic entry see Field 5C.  
W77-04416

**THE USE OF REMOTE SENSING FOR COASTAL ZONE MONITORING,**  
Texas A and M Univ., College Station. Remote Sensing Center.  
For primary bibliographic entry see Field 5B.  
W77-04475

**THE UTILIZATION OF THE APT AND ATS SATELLITE COMMUNICATION SYSTEMS IN COASTAL RESEARCH PROGRAMS,**  
Texas A and M University, College Station. Remote Sensing Center.  
For primary bibliographic entry see Field 2L.  
W77-04483

**BEHAVIOR OF FISH INFLUENCED BY HOT-WATER EFFLUENTS AS OBSERVED BY ULTRASONIC TRACKING,**  
Institute of Freshwater Research, Drottningholm (Sweden).  
For primary bibliographic entry see Field 5C.  
W77-04568

### 7C. Evaluation, Processing and Publication

**GROUND WATER RESOURCES OF THE BEDROCK AQUIFERS OF THE DENVER BASIN COLORADO,**  
Colorado Dept. of Natural Resources, Denver. Div. of Water Resources, Planning and Investigations.  
For primary bibliographic entry see Field 2F.  
W77-04126

**ALGAL ASSAYS FOR THE NATIONAL EUTROPHICATION SURVEY,**  
Pacific Northwest Environmental Research Lab., Corvallis, Oreg.  
For primary bibliographic entry see Field 5A.

## Field 7—RESOURCES DATA

### Group 7C—Evaluation, Processing and Publication

W77-04157

**FREQUENCY ANALYSIS OF CYCLIC PHENOMENA IN FLOWING STREAMS,**  
Army Engineers Waterways Experiment Station,  
Vicksburg, Miss.  
For primary bibliographic entry see Field 5C.

W77-04158

**OPTIMIZATION MODEL FOR THE DESIGN OF URBAN FLOOD-CONTROL SYSTEMS,**  
Texas Univ. at Austin. Center for Research in  
Water Resources.  
For primary bibliographic entry see Field 2E.

W77-04179

**DEVELOPMENT OF COMMERCIAL/INSTITUTIONAL PARAMETER UNITS FOR THE MAIN II SYSTEM OF WATER DEMAND FORECASTING,**  
Wyoming Univ., Laramie. Water Resources  
Research Inst.  
For primary bibliographic entry see Field 6D.

W77-04182

**GATE CONVECTION SUBPROGRAM DATA CENTER: SHIPBOARD PRECIPITATION DATA,**  
National Oceanic and Atmospheric Administration, Washington, D.C. Center for Experiment  
Design and Data Analysis.  
For primary bibliographic entry see Field 2B.

W77-04196

**U.S. IFYGL COASTAL CHAIN PROGRAM. REPORT 2: TRANSPORT, CURRENTS AND TEMPERATURE FROM THE UNITED STATES AND CANADIAN IFYGL COASTAL CHAIN STUDIES,**  
State Univ. of New York at Albany. Atmospheric  
Sciences Research Center.  
For primary bibliographic entry see Field 2H.

W77-04198

**RIVER BASIN SNOW MAPPING AT THE NATIONAL ENVIRONMENTAL SATELLITE SERVICE,**  
National Environmental Satellite Service,  
Washington, D.C.  
For primary bibliographic entry see Field 2C.

W77-04199

**DEVELOPMENT CAPABILITIES MAPS, SOUTHEASTERN NEW ENGLAND. WATER AND RELATED LANDS STUDY.**  
New England River Basins Commission, Boston, Mass.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-242 961, Price codes: A14 in paper copy, A01 in microfiche. January 1975. 6 maps, 1 overview.

Descriptors: \*Maps, \*Urban mapping, \*City planning, \*Resources development, \*Land management, \*Comprehensive planning, \*Aesthetics, \*New England, \*Massachusetts, \*Rhode Island, \*Water quality, \*Flooding, \*Water supply, Urbanization, Conservation, Regional economics, Economic impact, Regional analysis, Northeast U.S., Recreation, Erosion, Natural resources.

Identifiers: \*Boston(MA), \*Development capabilities map, \*Growth management, Recommended actions map.

Not intended as 'plan' maps, nor for use in 'site' planning, these maps are intended for identifying major issues at state, regional, subregional and inter-municipal levels; reviewing the compatibility of various agency and private plans with resource capability; and setting priorities for resource

management based on a more complete analysis of the resource base than has formerly been available. Development Capability Maps show critical environmental areas requiring protection, developable areas requiring management, preempted use areas, and transportation resources, including proposed new highways and services. Recommended Actions Maps delineate areas where problems of water supply, water quality, recreation, marine management, flooding and erosion, and unwelcome facilities (e.g., petroleum facility siting, generating station feasibility) are critical. Each type of map is provided for Greater Boston and North Shore, Southeastern Massachusetts, and Rhode Island and the Blackstone. Overview is a brief look at the findings and recommendations of the Southeastern New England (SENE) study. A thumbnail sketch of the major chapters in the Regional Report is given. (Hufschmidt-NC)

W77-04206

**FLOOD PLAIN INFORMATION: MARICOPA COUNTY, ARIZONA, VOLUME III, SKUNK CREEK REPORT.**

Army Engineer District, Los Angeles, Calif.  
For primary bibliographic entry see Field 4A.

W77-04210

**FLOOD PLAIN INFORMATION: HOCKING RIVER, ATHENS, OHIO.**

Army Engineer District, Huntington, W. Va.  
For primary bibliographic entry see Field 4A.

W77-04211

**FLOOD PLAIN INFORMATION: LITTLE ARKANSAS RIVER AND BLACK KETTLE CREEK, HALSTEAD, KANSAS.**

Army Engineer District, Tulsa, Okla.  
For primary bibliographic entry see Field 4A.

W77-04212

**FLOOD PLAIN INFORMATION: NORTH PLATTE, NEBRASKA; NORTH PLATTE RIVER AND SOUTH PLATTE RIVER.**

Army Engineer District, Omaha, Nebr.  
For primary bibliographic entry see Field 4A.

W77-04213

**FLOOD PLAIN INFORMATION: SIOUX CITY, IOWA, VOLUME I, PERRY CREEK,**

Army Engineer District, Omaha, Nebr.  
For primary bibliographic entry see Field 4A.

W77-04214

**FLOOD PLAIN INFORMATION: STEAMBOAT CREEK AND TRIBUTARIES, STEAMBOAT AND PLEASANT VALLEYS, NEVADA.**

Army Engineer District, Sacramento, Calif.  
For primary bibliographic entry see Field 4A.

W77-04215

**FLOOD PLAIN INFORMATION: SAND AND COTTONWOOD CREEKS AND THE LOWER KAWEAH RIVER, VISALIA, CALIFORNIA.**

Army Engineer District, Sacramento, Calif.  
For primary bibliographic entry see Field 4A.

W77-04216

**SPECIAL FLOOD HAZARD INFORMATION REPORT: BETZ ROAD DITCH, CITY OF BELLEVUE, NEBRASKA.**

Army Engineer District, Omaha, Nebr.  
For primary bibliographic entry see Field 4A.

W77-04217

**SPECIAL FLOOD HAZARD INFORMATION REPORT: NORTH FORK BIG NEMAHIA RIVER**

**AND TOWN BRANCH, TECUMSEH, NEBRASKA.**

Army Engineer District, Kansas City, Kans.  
For primary bibliographic entry see Field 4A.

W77-04218

**SPECIAL FLOOD HAZARD INFORMATION REPORT: SOUTH BRANCH WEST FORK BIG BLUE RIVER, HASTINGS, NEBRASKA.**

Army Engineer District, Kansas City, Kans.  
For primary bibliographic entry see Field 4A.

W77-04219

**SPECIAL FLOOD HAZARD INFORMATION REPORT: REPUBLICAN RIVER AND CROOKED CREEK, RED CLOUD, NEBRASKA.**

Army Engineer District, Kansas City, Kans.  
For primary bibliographic entry see Field 4A.

W77-04220

**GROUND-WATER RESOURCES OF THE WHITE RIVER JUNCTION AREA, VERMONT.**  
Geological Survey, Montpelier, Vt. Water Resources Div.

For primary bibliographic entry see Field 4B.

W77-04221

**GROUND-WATER RESOURCES OF THE BARRE-MONTPELIER AREA, VERMONT.**  
Geological Survey, Montpelier, Vt. Water Resources Div.

For primary bibliographic entry see Field 4B.

W77-04222

**WATER RESOURCES OF SOUTH-CENTRAL MISSOURI.**

Geological Survey, Rolla, Mo. Water Resources Div.

E. E. Gann, E. J. Harvey, and D. E. Miller.  
Available from U.S. Geological Survey, Reston, VA 22092, price \$5.00. Hydrologic Investigation Atlas HA-550, 1976. 4 sheets, 58 ref.

Descriptors: \*Water resources, \*Surface waters, \*Groundwater resources, \*Water quality, \*Missouri, Water demand, Water supply, Urbanization, Recreation facilities, Lakes, Aquifers, Pumping, Streamflow, Flow rates, Hydrologic data, Maps, Hydrographs.  
Identifiers: South-Central Missouri.

This atlas describes hydrology in an area of approximately 23,000 sq mi and includes all or parts of 38 counties in Missouri. The area is bounded on the north by the southern edge of the Missouri River flood plain, on the east by the Mississippi River and the Plateaus-Lowlands boundary (Ozark Escarpment), on the south by the Missouri-Arkansas State line, and on the west by the western drainage divides of the Gasconade and White River basins. The alluvial valley of the Missouri River is excluded. Although the populations of several rural counties in the area have declined in recent years, significant population increases have occurred in the vicinity of the two principal population centers, St. Louis in the northeast and Springfield in the southwest. Future population increases are expected to occur as a result of continued urban expansion, increased recreational use of land and water resources, and additional development of the mining industry. (Woodard-USGS)

W77-04223

**IDENTIFICATION CODES FOR ORGANIZATIONS LISTED IN COMPUTERIZED DATA SYSTEMS OF THE U.S. GEOLOGICAL SURVEY,**

Geological Survey, Reston, Va. Water Resources Div.

For primary bibliographic entry see Field 7A.

W77-04224

**DIRECTORY OF LOCAL ASSISTANCE CENTERS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),**  
Geological Survey, Reston, Va. Water Resources Div.  
M. D. Edwards.  
Open-file report 76-880, 1977. 11 p.

Descriptors: \*Information retrieval, \*Information exchange, \*Hydrologic data, \*Data storage and retrieval, Organizations.

Identifiers: Local assistance centers, Directory, \*Water-data acquisition, National Water Data Exchange(NAWDEX).  
W77-04228

The National Water Data Exchange (NAWDEX), managed by the U.S. Geological Survey, has established a network of Local Assistance Centers throughout the United States and Puerto Rico to assist users of water data in identifying and locating the data they need. This Directory provides the information needed to contact any of the established Centers. (Woodard-USGS)  
W77-04225

**WATEQF-A FORTRAN IV VERSION OF WATEQ, A COMPUTER PROGRAM FOR CALCULATING CHEMICAL EQUILIBRIUM OF NATURAL WATERS,**  
Geological Survey, Reston, Va. Water Resources Div.

L. N. Plummer, B. F. Jones, and A. H. Truesdell. Available from the National Technical Information Service, Springfield, VA 22161 as PB-261 027, Price codes: A04 in paper copy, A01 in microfiche. Water-Resources Investigations 76-13, September 1976. 61 p, 1 tab, 17 ref.

Descriptors: \*Computer models, \*Water chemistry, \*Equilibrium, \*Stability, \*Natural streams, \*Computer programs, Methodology, Analytical techniques, Thermodynamics, Ions.  
Identifiers: \*FORTRAN IV computer programs, WATEQF computer program.

WATEQF is a FORTRAN IV computer program that models the thermodynamic speciation of inorganic ions and complex species in solution for a given water analysis. The original version (WATEQ) was written in 1973 by A. H. Truesdell and B. F. Jones in Programming Language/one (PL/I). With but a few exceptions, the thermochemical data, speciation, coefficients, and general calculation procedure of WATEQF is identical to the PL/I version. This report notes the differences between WATEQF and WATEQ, demonstrates how to set up the input data to execute WATEQF, provides a test case for comparison, and makes available a listing of WATEQF. (Woodard-USGS)  
W77-04226

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 2. SUSQUEHANNA AND POTOMAC RIVER BASINS.**  
Geological Survey, Harrisburg, Pa. Water Resources Div.  
Water-Data Report PA-75-2, October 1976. 363 p, 6 fig, 6 tab, 35 ref.

Descriptors: \*Pennsylvania, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Sampling, Sites, Water levels, Water analysis.

Water Resources Data for the 1975 water year for Pennsylvania consists of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report on the Susquehanna and Potomac River basins, contains discharge records for 92 gaging stations; stage and contents for 10

lakes and reservoirs; water quality for 41 gaging stations, 68 partial-record flow stations, and water levels for 36 observation wells. Also included are data for 23 crest-stage partial-record stations and 39 low-flow partial-record stations. Additional data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Pennsylvania. (Woodard-USGS)  
W77-04228

**TERRACES AND SHORELINES OF FLORIDA,**  
Geological Survey, Tallahassee, Fla. Water Resources Div.  
H. G. Healy.

Florida Bureau of Geology Map Series No 71, 1975. 1 sheet, 1 fig, 1 tab, 40 ref.

Descriptors: \*Terraces(Geologic), \*Shores, \*Maps, \*Florida, \*Groundwater, Geologic formations, Geologic time, Glaciation, Glacial sediments, Geology, Hydrogeology, Sedimentation, Mineralogy, Mapping, Methodology.

This map shows the extent and distribution of identified terraces and shorelines in Florida. The topography of Florida is the result of different erosional and depositional processes that have sculptured the landscape through thousands of years. One of the most striking features in Florida as well as in many areas along the eastern seaboard is the persisting step-like surfaces, or terraces, associated with the advances and retreats of the sea during the Pleistocene Epoch or the 'Great Ice Age.' The changes of sea level associated with the repeated retreat and growth of continental glaciers have left their imprint with such physiographic features as terraces, wave-cut scarps or shorelines, beach dunes and offshore bars. Mineral deposits associated with terraces, shore, and near-shore features are of economic importance. Terraces also play an important role in hydrologic regimen of ground water in many areas. The altitude of the terrace relative to adjacent land and the size or sorting of sediments underlying the terrace are factors that affect the occurrence and movement of ground water. (Woodard-USGS)  
W77-04229

**WATER RESOURCES OF THE BIG FORK RIVER WATERSHED, NORTH-CENTRAL MINNESOTA,**  
Geological Survey, Grand Rapids, Minn. Water Resources Div.

G. F. Lindholm, J. O. Helgesen, and D. W. Ericson.  
Available from Branch of Distribution, USGS, 1200 S. Eads St., Arlington, VA 22202, price \$3.00. Hydrologic Investigations Atlas HA-549, 1976. 2 sheets, 14 ref.

Descriptors: \*Water resources, \*Surface waters, \*Groundwater resources, \*Water quality, \*Minnesota, Hydrologic budget, Water utilization, Hydrogeology, Aquifer characteristics, Ground-water movement, Streamflow, Lakes.  
Identifiers: \*Big Fork River watershed(Minn).  
W77-04230

The Big Fork River watershed is one of 39 watershed units designated by the Minnesota Department of Natural Resources for evaluation of the State's water resources. Included is an appraisal of the occurrence, quantity, quality, and availability of ground and surface waters. Water resources are not intensively developed anywhere in the watershed. Most development is in the southern half, as much of the northern half is peat-covered wetlands. Essentially all water used is withdrawn from ground-water sources, mainly glacial drift, which ranges from 0 to 250 feet in thickness. Most ground water is of the calcium or sodium bicarbonate type. The degree of mineralization increases down-gradient in the flow

system. Groundwater is typically very hard and high in iron and manganese. Lakes and large areas of wetlands have a natural regulating effect on streamflow. Water in streams is of the calcium bicarbonate type. The amount of mineralization at a given time reflects surficial geology, being greatest in streams draining till areas and least in streams draining peatlands. Water drained from peatlands is commonly higher in color and iron and lower in pH than water from areas of mineral soil. (Woodard-USGS)  
W77-04233

**GEOHYDROLOGIC MAPS OF THE POTOMAC-RARITAN-MAGOOTHY AQUIFER SYSTEM IN THE NEW JERSEY COASTAL PLAIN,**  
Geological Survey, Trenton, N. J. Water Resources Div.  
H. E. Gill, and G. M. Farlekas.

Available from Branch of Distribution, USGS, 1200 S. Eads St., Arlington, Va. 22202, price \$3.00. Hydrologic Investigations Atlas HA-557, 1976. 2 sheets, 9 maps, 11 ref.

Descriptors: \*Geohydrologic units, \*Aquifers, \*Subsurface mapping, \*Confined water, \*New Jersey, Atlantic Coastal Plain, Groundwater, Bedrock, Potentiometric level, \*Maps.  
Identifiers: \*Potomac-Raritan-Magoothy aquifer system.

The Potomac Group and the Raritan and Magothy Formations of late Early to early Late Cretaceous age form an aquifer system consisting chiefly of interlayered beds of quartz sand, silt, and clay. The aquifer system is the most heavily pumped in New Jersey and contains fresh water over an area of about 2,500 sq mi. This atlas illustrates some of the geohydrologic information available for the aquifer system and its confining units. The maps show the configuration of the bedrock surface and the altitude of the top of the confining unit above the aquifer system. Also included are maps depicting the altitude of the top of the aquifer system, three time-related potentiometric surface configurations, and three head declines of the aquifer system. The area represented by these maps lies within the Coastal Plain physiographic province (Fenneman, 1938) and is almost entirely within New Jersey. The area is a low lying, gently rolling plain that ranges in altitude from sea level to about 390 ft. (Woodard-USGS)  
W77-04234

**WATER RESOURCES OF THE BIGHORN BASIN, NORTHWESTERN WYOMING,**  
Geological Survey, Cheyenne, Wyo. Water Resources Div.

M. E. Lowry, H. W. Lowham, and G. C. Lines.  
Available from Branch of Distribution, USGS, Box 25286, Federal Ctr., Denver, Colo. 80225, price \$3.00. Hydrologic Investigations Atlas HA-512, 1976. 2 sheets, 47 ref.

Descriptors: \*Water resources, \*Surface waters, \*Groundwater resources, \*Water quality, \*Wyoming, Aquifer characteristics, Pumping, Streamflow, Flow rates, Snowmelt, Water supply, Hydrologic data, \*Maps, Hydrographs.  
Identifiers: \*Bighorn basin(Wyo).  
W77-04235

This 2-sheet map report includes the part of the Bighorn Basin and adjacent mountains in northwestern Wyoming. Water-bearing properties of the geologic units are summarized. The hydrogeologic map illustrates the distribution of wells in the different units and gives basic data on the yields of wells, depth of wells, depth to water, and dissolved solids and conductance of the water. Aquifers capable of yielding more than 1,000 gpm (gallons per minute) underlie the area everywhere, except in the mountains on the periphery of the basin. In 1970, approximately 29,500 of the 40,475 people living in the Bighorn Basin were served by municipal water supplies. The municipal supply for about 6,300 of these people was from ground

## Field 7—RESOURCES DATA

### Group 7C—Evaluation, Processing and Publication

water. The natural flows of streams in the Bighorn Basin differ greatly due to a wide range in the meteorologic, topographic, and geologic conditions of the basin. The station locations and the average discharge per square mile are shown on the map and give an indication of the geographic variation of basin yields. The maximum instantaneous discharge that has occurred at each station during its period of record is shown. Most of the runoff in the basin is from snowmelt in the mountains. (Woodard-USGS)  
W77-04235

**MAP SHOWING GROUND-WATER CONDITIONS IN THE ARAVAIPA VALLEY AREA, GRAHAM AND PINAL COUNTIES, ARIZONA—1975,**  
Geological Survey, Tucson, Ariz. Water Resources Div.  
J. A. Gould, and R. P. Wilson.  
Water-Resources Investigations 76-107 (open-file report), September 1976. 1 sheet, 5 ref.

Descriptors: \*Groundwater resources, \*Aquifer characteristics, \*Water yield, \*Water quality, \*Water utilization, Arizona, \*Maps, Hydrogeology, Water supply, Irrigation, Livestock, Domestic water.  
Identifiers: \*Graham and Pinal Counties (Ariz), Aravaipa Valley area.

This hydrologic map of the Aravaipa Valley area includes about 500 sq mi in southeastern Arizona. Development of the ground-water resources is small, and pumping is estimated to be less than 3,000 acre-ft annually for irrigation, livestock, and domestic uses. Hydrographs of the water level in selected wells show no long-term decline. Irrigation wells yield as much as 1,200 gal/min from the younger and older alluvium along Aravaipa Creek. The chemical quality of the ground water generally is good. (Woodard-USGS)  
W77-04236

**STATUS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX)—SEPTEMBER 1976,**  
Geological Survey, Reston, Va. Water Resources Div.

M. D. Edwards.  
Open-file report 76-719, 1976. 23 p, 3 tab, 2 append.

Descriptors: \*Data storage and retrieval, \*Information exchange, \*Hydrologic data, \*Publications, \*Abstracts, Bibliographies, Information retrieval, Reviews.  
Identifiers: \*Data-search assistance, \*National Water Data Exchange (NAWDEX), WATSTORE, STORET, Water-data index.

The National Water Data Exchange (NAWDEX) has been established to assist users of water data in the identification, location, and acquisition of needed data. NAWDEX is not a depository of water data; its objectives are to provide the user with sufficient information to define what data are available, where these data may be obtained, and in what form they are available; also to describe some of their major characteristics. NAWDEX is comprised of water-oriented organizations in the Federal, State, and local governments, and in the academic and private sectors of the water-data community who work together to make their water data readily and conveniently available. Data search and referral services are currently provided through the Program Office established by the U.S. Geological Survey which has the lead-role responsibility for NAWDEX operations. During its first year of operation, a computerized Water Data Sources Directory was developed which identifies more than 300 organizations that collect water data, the types of data they collect, and the locations within these organizations from which the data may be obtained. NAWDEX is expanding its services and is establishing a nationwide network of Local Assistance Centers for local users' access to these services. (Woodard-USGS)

W77-04237

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 1. DELAWARE RIVER BASIN.**  
Geological Survey, Harrisburg, Pa. Water Resources Div.  
Water-Data Report PA-75-1, October 1976. 385 p, 10 fig, 9 tab, 35 ref.

Descriptors: \*Pennsylvania, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Sampling, Sites, Water levels, Water analysis, \*Delaware River.

Water Resources Data for the 1975 water year for Pennsylvania consists of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, on the Delaware River basin, contains discharge record for 76 gaging stations; stage and contents for 10 lakes and reservoirs; water quality for 55 gaging stations, 56 partial-record flow stations, and water levels for 16 observation wells. Also included are data for 40 crest-stage partial-record stations and 37 low-flow partial-record stations. Additional data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Pennsylvania. (Woodard-USGS)  
W77-04242

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1975—VOLUME 3. OHIO RIVER AND ST. LAWRENCE RIVER BASINS.**  
Geological Survey, Harrisburg, Pa. Water Resources Div.  
Geological Survey Water-Data Report PA-75-3, October 1976. 196 p, 5 fig, 5 tab, 35 ref.

Descriptors: \*Pennsylvania, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, \*Ohio River, St. Lawrence River.

Water Resources Data for the 1975 water year for Pennsylvania consists of records of stage, discharge, and water quality in wells and springs. This report on the Ohio and St. Lawrence River basins, contains discharge records for 89 gaging stations; stage and contents for 14 lakes and reservoirs; water quality for 2 gaging stations, 46 partial-record flow stations, and water levels for 20 observation wells. Also included are data for 12 crest-stage partial-record stations and 27 low-flow partial-record stations. Additional data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Pennsylvania. (Woodard-USGS)  
W77-04243

**ARIZONA LAND USE EXPERIMENT,**  
Arizona Resources Information System, Phoenix.  
For primary bibliographic entry see Field 7B.  
W77-04245

**APPLICATION OF A THREE-DIMENSIONAL MODEL TO COMPUTATIONS OF STORM SURGES IN THE BLACK SEA.**  
For primary bibliographic entry see Field 2B.  
W77-04260

**MODEL-FREE STATISTICAL METHODS FOR WATER TABLE PREDICTION,**  
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.  
For primary bibliographic entry see Field 4B.  
W77-04264

**OCEANOGRAPHIC COMMISSION,**  
Oceanographic Commission of Washington, Olympia.  
For primary bibliographic entry see Field 6E.  
W77-04359

**IN INTENSIVE BIOMETRIC INTERTIDAL SURVEY (PROJECT IBIS). A SALT MARSH MONITORING STUDY,**  
American Univ., Washington, D.C. Marine Science Program.  
For primary bibliographic entry see Field 2L.  
W77-04478

**COMPUTER PROGRAM FOR PRESENTING ACTUAL LAKE DATA, (IN GERMAN),**  
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).  
H. Buehler.  
Schweiz Z Hydrol 37(2), p 332-346, 1975.

Descriptors: \*Computer programs, Lakes, \*Oxygen demand, Data processing, Temperature, Carbon, Water pollution.  
Identifiers: Calcite, Oxygen saturation.

Data concerning lake surveys are processed in a computer program. New formulas for calculating conductivity at 20°C, O<sub>2</sub> saturation and temperature correction in the inorganic C equilibrium system are given. An approximation of the O<sub>2</sub> demand in lakes and an estimation of the solubility of calcite are also provided.—Copyright 1976, Biological Abstracts, Inc.  
W77-04585

## 8. ENGINEERING WORKS

### 8A. Structures

**ROLE OF THE HEAT STORAGE WELL IN FUTURE U.S. ENERGY SYSTEMS,**  
General Electric TEMPO, Santa Barbara, California, Center for Advanced Studies.  
For primary bibliographic entry see Field 4B.  
W77-04145

### 8B. Hydraulics

**THE DREAM SPUDDER,**  
Plummer and McDannald, Westerville, Ohio.  
R. B. McDannald.  
Water Well Journal, Vol. 32, No. 1, p 25, January, 1977.

Descriptors: \*Water wells, \*Drilling equipment, Topography, Limestone, Shales.  
Identifiers: \*Cable tool rig modifications.

The optimum cable tool rig for the Central Ohio area would be a modified version of presently manufactured spudders. Considering the terrain, flat-to-hilly top soil and clay with formations from up to glacial till with sand and gravel lenses as deep as 300 ft, to limestone bedrock two feet below the surface, the truck should have all wheel drive and be small or short enough to handle well in tight places. It should have large wheels, but the rig should be mounted low enough to avoid a high step to the controls. For leveling the rig there should be three built-in leveling jacks scaled down to avoid unnecessary weight. The jacks should have two-way, no-creep valves to prevent con-

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## ENGINEERING WORKS—Field 8

### Hydraulics—Group 8B

stant adjusting. Borrowed from the rotary rig would be the expanded, metal foldup drilling platforms attached to the back of the rig. A one-piece tubular derrick with hydraulic rams used as braces would be helpful. Fixtures to hold the drill stem and bailers during transport could be easily released without climbing into the derrick. A 15 ft. by 6 1/2 in. post hole auger type attachment in the derrick would make it easier to abide the EPA requirement of at least 15 ft. or more of grout in the annular space. The same hydraulic system would hinge the auger attachment as would power the jacks and derrick and the auger swing and rotation, making the power transference a simple matter. The rig motor should include a low oil pressure shut-off and an automatic, over-heated engine shut-off. The engine should be propane-powered for long life and low maintenance and wear. The propane tank should be large enough to complete a well without refill, or a duel fuel system should be installed. (Grober-NWWA) W77-04116

#### ENERGY COSTS DICTATE EFFICIENT WELL DESIGN,

R. J. Havrilak.

The Johnson Drillers Journal, Vol. 48, No. 6, p 1-2, 13-14, November-December, 1976. 2 fig.

Descriptors: \*Water wells, \*Irrigation, Groundwater, Sampling, Electrical well logging, Economic efficiency, \*Texas.

Identifiers: \*Well design, Test hole, Gamma ray well logs, Ogallala formation, High Plains Research Foundation, Halfway(Tex).

After the introduction of systematic irrigation, the Texas high plains area became a major agricultural region. Water is basic to the health and survival of that region's well-being, and its loss would mean the devastation of the agricultural economy. The prospect of total depletion of ground water in the area is improbable, however, other problems have arisen that threaten this water-based economy—(1) increasing cost of energy, (2) declining water levels throughout the Ogallala formation, the source of the region's ground water, and (3) the development of increasingly sophisticated irrigation equipment. The High Plains Research Foundation has been aware of the problems and has been working toward their solutions. The Agricultural Experiment Station at Halfway, Texas was the site of a 1,300 gpm well. The primary purpose of the well is to emphasize that through correct design and development, an efficient pumping irrigation plant is possible which will provide maximum amounts of water while completely eliminating the pumping of sand which plagues the majority of wells in the area. Important steps for the new well installation include: drilling a test hole, analysis of carefully taken samples, and the running of electric and gamma ray logs. The self-destroying characteristic of the drilling fluid additive, along with bailing and high pressure jetting assure the well's permeability will be unimpaired. Neither the principles of the Halfway, Texas well, nor the technology required for their application are new. What is new is the wider awareness of the economic merits of properly designed engineered wells. (Grober-NWWA) W77-04119

#### SHORT, LARGE DIAMETER SCREENS PROVE EFFECTIVE,

For primary bibliographic entry see Field 8G.

W77-04120

#### LOW-COST CHEMICAL CUTS SAND PROBLEMS IN HEAVY OIL FIELD,

Getty Oil Co., Bakersfield, Calif.

For primary bibliographic entry see Field 8G.

W77-04124

**EVALUATING WELL CONSTRUCTION,**  
Agricultural Research Service, Beltsville, Md.  
Agricultural Engineering Research Div.  
E. E. Jones.  
Journal of Environmental Health, Vol. 36, No. 6,  
May-June, 1974. 3 fig, 4 tab, 3 ref.

Descriptors: \*Water wells, \*Water pollution,  
\*Groundwater, \*Construction, Concrete placing,  
Construction materials, Casings.  
Identifiers: \*Water well construction, \*Sanitary  
protection.

A water well is evaluated by the water it produces. Because there is no such thing as a well that is contaminated the same amount at all times, indication of rapid changes in water quality with time after the start of pumping can be used to differentiate between contamination entering the well and poor ground-water quality. Entry of the contaminant involves three factors; (1) The contaminant source, (2) A transmission path, and (3) A transmitting fluid. Many factors are involved in the residual contaminant concentration in a well water sample. Knowledge of the nature and behavior of the contaminant can provide important clues to the path of entry and aid in determining the deficiencies in the sanitary protection of the well. (Heiss-NWWA) W77-04131

#### WELL CONSTRUCTION AND WATER QUALITY,

Agricultural Research Service, Beltsville, Md.  
Agricultural Engineering Research Div.

For primary bibliographic entry see Field 5G.

W77-04132

#### USING UNCONFORMITIES TO LOCATE WELLS,

National Water Well Association, Worthington,  
Ohio.

For primary bibliographic entry see Field 8E.

W77-04133

#### HYDROGEOLOGIC STUDY, NEW HORIZONS SUBDIVISION, CARROLL COUNTY, MARYLAND,

Maryland Dept. of Natural Resources, Annapolis.  
Water Resources Administration.

For primary bibliographic entry see Field 4B.

W77-04140

#### MANNING'S ROUGHNESS FOR ARTIFICIAL GRASSES,

École Polytechnique Federale de Lausanne  
(Switzerland). Laboratoire d'Hydraulique.

For primary bibliographic entry see Field 4A.

W77-04255

#### SEGMENTAL ORIFICES WITH SHUNT METERS TO TOTALIZE PIPELINE FLOW,

Agricultural Research Service, Fort Collins, Colo.  
E. G. Kruse, and D. A. Young.

Transactions of the American Society of Agricultural Engineers, Vol. 19, No. 5, p 871-875, September-October 1976. 7 fig, 2 tab, 3 ref.

Descriptors: \*Pipe flow, \*Flow rates,  
\*Measurement, \*Irrigation engineering, Instrumentation, Calibrations, Laboratory tests, Orifices, Discharge(Water), Discharge measurement, Flowmeters, \*Flow measurement, On-site tests.

Four segmental orifice plates were constructed and evaluated for use with domestic water meters in shunt lines for totalizing irrigation flow. Total pipe flow was related to shunt-line flow in the laboratory; then two field installations in self-propelled, center-pivot sprinklers were evaluated for two seasons. After two years of field evaluations, an accuracy of plus or minus 8% of true flow was noted, which is suitable for use in determining

groundwater draft by irrigation wells.  
(Humphreys-ISWS)  
W77-04269

**SAMPLING: ONE KEY TO DRILLING SUCCESS,**  
Universal Oil Products, St. Paul, Minn. Johnson  
Div.  
For primary bibliographic entry see Field 8G.  
W77-04279

**A STUDY OF TUBEWELL INSTALLATIONS IN BETUL DISTRICT MADHYA PRADESH, INDIA,**  
E. L. C. Water Development Project, Betul (India).  
January, 1976. p 25, 4 fig, 4 tab, 9 append.

Descriptors: \*Water wells, \*Groundwater, \*Water pollution control, \*Pumps, Pumping.  
Identifiers: \*Sholapur pump, Mahasagar pump, Jalval pump, \*Mahhya Pradesh(India).

The E.L.C. Water Development Project was the first to drill tubewells in the area of Madhya in 1970. Approximately 400 villages now benefit from improved water supplies. WDP is planning to make a contractual arrangement with the Government to repair and maintain hand pumps in two-thirds of the Betul District, and is now installing the Sholapur Pump, which is less prone to malfunctions. The originally installed Mahasagar Pump was unreliable as it was not designed for deep water conditions and contained many movable parts prone to breakage and wear. The Jalval Pump was then developed with a sturdier design, which reduced maintenance costs. This design is very similar to the Sholapur Pump. Water Development Project is working with the Public Health Engineering Department to implement improvements to their maintenance and repair program. Piped water supply schemes are very inefficient run and in some cases do not function at all. Recently, Padhar Hospital initiated a community health scheme to improve conditions. Resource allocation has become the major problem for the project. Considerable results have been achieved in Betul, although there are many weaknesses still present in the implementation of water supply schemes. (Grober-NWWA) W77-04284

#### ARTIC CASING PACK,

For primary bibliographic entry see Field 8G.  
W77-04286

#### SECOND TEST DRILLING PROGRAM BEGUN TO SUPPORT RREP.

For primary bibliographic entry see Field 8G.  
W77-04290

#### IMPROVED CEMENTING TECHNIQUES FOR LARGE DIAMETER CASING,

Baker International Corp., Houston, Tex. Baker-line Div.

For primary bibliographic entry see Field 8F.

W77-04291

#### IRRIGATION WELL EFFICIENCY,

Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources.

G. Morin.

In: Proceedings Irrigation Short Course, January 24-25, 1977, Lincoln, Nebraska, Nebraska Center for Continuing Education, p 125-133, 4 fig, 2 tab, 4 ref.

Descriptors: \*Irrigation wells, Theis equation, Energy conservation, Irrigation efficiency.  
Identifiers: \*Well efficiency, \*Energy requirements, Efficiency reduction, Well log, Energy costs, Well development.

## Field 8—ENGINEERING WORKS

### Group 8B—Hydraulics

An inefficient well requires additional energy to pump a given amount of water. A well may be so inefficient that it will be unable to yield the desired amount of water. Reduced efficiency is caused by the aquifer material or gravel pack surrounding the well being clogged with fine salts and clays or because the casing perforations were inadequate at installation or became clogged. Dissolved chemicals can also precipitate around the casing perforation reducing efficiency. Bacteria may also clog perforations. To detect well efficiency it is necessary to keep a well record containing information relating to the well and pump specifications, a record of materials penetrated while drilling the well, data obtained during initial pumping of the well and methods used to develop the well. Well efficiency can be calculated in two ways. The 'well log' method provides an estimate of the drawdown in the well based on estimates of the transmissivity of subsurface materials. The match point method is more accurate and is based on calculations resulting from a pump test and data collected in a nearby observation well. If an efficient well is desired than a reputable well driller should design, install and develop the well. He will choose the proper casing material and gravel pack to assure maximum well efficiency. To maintain well efficiency periodic treatment or redevelopment may be necessary. (Gass-NWWA)  
W77-04292

**MAKING WATER AVAILABLE FOR IRRIGATION,**  
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 4B.  
W77-04293

**INVESTIGATION INTO METHODS FOR DEVELOPING A PHYSICAL ANALYSIS FOR EVALUATING INSTREAM FLOW NEEDS,**  
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.  
For primary bibliographic entry see Field 2E.  
W77-04296

**SHORELINE WAVES, ANOTHER ENERGY CRISIS,**  
Virginia Inst. of Marine Science, Gloucester Point.  
For primary bibliographic entry see Field 2L.  
W77-04467

**BEACH FILL PLANNING - BRUNSWICK COUNTY, NORTH CAROLINA,**  
Army Engineer District, Wilmington, Del. Coastal Engineering Studies Section.  
For primary bibliographic entry see Field 2L.  
W77-04471

### 8C. Hydraulic Machinery

**PUMP HANDBOOK.**  
Worthington Pump Inc., Newark, N.J.  
For primary bibliographic entry see Field 8G.  
W77-04114

**FREE PUMP TESTS SAVE MILLIONS OF DOLLARS,**  
For primary bibliographic entry see Field 8G.  
W77-04118

**FIELD APPLICATION OF EXTERNALLY STRESS-RELIEVED DRILL COLLARS,**  
Shell Oil Co., Denver, Colo.  
For primary bibliographic entry see Field 8G.  
W77-04130

**SUPERHARD MATERIALS PROMISE EXTENDED WEAR CAPABILITY,**  
Sabre Drill Bits, Inc., Philadelphia, Pa.

For primary bibliographic entry see Field 8G.  
W77-04283

**COLLARS WITH ER GROOVES HAD FEWER CONNECTION FAILURES,**  
Shell Oil Co., Ventura, Calif.

For primary bibliographic entry see Field 8G.  
W77-04285

**SPARKLE PLENTY,**  
For primary bibliographic entry see Field 8G.  
W77-04287

**BAILING,**  
Plummer and McDannald Co., Westerville, Ohio.  
R. B. McDannald.  
Water Well Journal, Vol. 30, No. 12, p 22-23, December, 1976.

Descriptors: \*Drilling equipment, \*Water wells, Drawdown, Drilling fluids, Geologic formations.  
Identifiers: \*Percussion drilling, \*Bailing, \*Flat valve bailer, \*Dart valve bailer, \*Gravel bailer, Well development, Caving formations, Consolidated formations.

Bailing is an integral part of the percussion drilling process. Certain conditions dictate the frequency of bailing. If the mixture thickens and the rig engine speed must be reduced to keep the rhythm of the falling tools, the well must be bailed. As mud in soft formations tends to prevent caving, in caving formations bail out only the thicker and heavier part at the bottom of the hole. When drilling a consolidated formation, the bailing operation is quite routine. After each run (an average of 3 1/2 - 6 ft), the tools are pulled from the hole and the bailer is run. Normally a bailer is composed of seamless tubing, on the bottom of which is a valve that closes to hold the material when the bailer is raised. It is fitted with a loop or bail at the top where the sand line is attached. The Flat Valve Bailer has a flapper valve at the bottom which opens when raised. For holes up to 12 inches in diameter best results will be obtained if the bailer diameter selected is about one to two inches less than that of the hole. The Flat Valve Bailer is also frequently used to obtain samples of the formation through which the drill passes. The Dart Valve Bailer is more generally used because of its convenience in dumping. It is particularly useful for testing drawdown and capacity of small-diameter or low-yield wells. The Sand Pump or Gravel Bailer, because of its inside plunger action, generally picks up more material close to the bottom. Several types of sand pumps are available. This type of bailer makes an easier job of developing gravel wells; however, because of its higher cost, relatively few drillers use it. (Grober-NWWA)  
W77-04288

**GOOD PLANNING IS THE KEY TO DEVIATION CONTROL,**

Texas Pacific Oil Co., Clagary (Canada).  
C. G. Bohme, J. K. Farries, and R. W. Logan.  
World Oil, Vol. 183, No. 7, p 65-69, December, 1976. 4 fig, 3 tab.

Descriptors: \*Drilling, \*Drilling equipment, \*Drilling monitors, \*Geologic formations, Rock mechanics, Casings, Faults, Fissures, Folds, Fractures, Canada.  
Identifiers: \*Deviation holes, \*Doglegs, \*Key seat, Deviation bits, Regional drift, Rocky Mountain Foothills, Western Canada.

Radical deviation and direction changes of formations in the foothills region of Western Canada can result in sharp doglegs that lead to key seats and their associated hole problems. Deviation control begins with careful planning. Information can be obtained from offset well records, seismic and surface geological data to help predict the dip and

strike of the formation. The well plan should call for a straight surface hole with gradual deviation allowed in the upper intermediate section of the well. The surface hole is kept as straight as possible to avoid surface casing wear and to allow the well to start straight from below the surface casing shoe. After the surface hole is completed, many operators set a much heavier casing string than is required to allow for casing wear that often occurs. Deviation problems will probably occur when a formation change is encountered. As penetration rates increase the tendency is to drill the hole too fast without checking the deviation often enough. If hole angle tends to drop radically, a directional survey should be run to check for a severe direction change. If the hole cannot be kept on course by using various drilling assemblies, deviation bits can be used to drop angle and change direction. Corrective measures should be taken in soft formations where the hole can be more readily turned than in hard formations. The procedure that has been most successful in the foothills, using deviation bits, is to carry high weights and use slick string with only one stabilizer or string reamer. Careful planning can establish realistic hole deviation limits while allowing faster penetration rates. (Heiss-NWWA)  
W77-04289

### 8D. Soil Mechanics

**LEACHATE DAMAGE ASSESSMENT, CASE STUDY OF THE PEOPLES AVENUE SOLID WASTE DISPOSAL SITE IN ROCKFORD, ILLINOIS,**  
Environmental Protection Agency, Cincinnati, Ohio. Office of Solid Waste Management Programs.

For primary bibliographic entry see Field 5B.  
W77-04122

**STEADY NON-DARCIAN SEEPAGE THROUGH EMBANKMENTS,**  
Punjab Agricultural Univ., Ludhiana (India). Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2F.  
W77-04256

### 8E. Rock Mechanics and Geology

**WELL LOGGING MANUAL.**  
Scientific Software Corp., Denver, Colo.  
For primary bibliographic entry see Field 8G.  
W77-04115

**IMPROVED DRILLING IS A RESULT OF SOUND ENGINEERING,**  
West Engineering, Inc., Midland, Tex.  
For primary bibliographic entry see Field 8G.  
W77-04121

**USING UNCONFORMITIES TO LOCATE WELLS,**  
National Water Well Association, Worthington, Ohio.  
T. E. Gass.  
Water Well Journal, Vol. 30, No. 12, p 26-27, December, 1976, 4 fig.

Descriptors: \*Fractures, \*Porosity, \*Permeability, Fissures, Erosion, Igneous rocks, Sedimentary rocks, Wisconsin.  
Identifiers: \*Unconformities, Angular unconformity, Disconformity, Nonconformity, Paraconformity, Platteville dolomite formation (Wisc.).

An unconformity is any surface that separates one set of rocks from another younger set of rocks. This surface may represent a long period of non-deposition in a sedimentary sequence, or it can be

surfaceous kind on opposite forms and the reverse of the u-shaped nonconformities which in the case of overlying formations located be the a. (W77-04289)

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surface of weathering and erosion. There are various kinds of unconformities. When the rock units on opposite sides of the break are not parallel they form an angular unconformity. A disconformity is the reverse, the rock formations on opposite sides of the unconformity are parallel, with appreciable relief of the lower member. If the unconformity separates different kinds of rocks, for example sedimentary rocks from igneous rocks, it is called a nonconformity. Paraconformities are recognized when the breaks resemble an ordinary bedding plane. It is often difficult to recognize unconformities while drilling except where a nonconformity is encountered. Sudden changes in lithology are typical of unconformities or faults. When rock formations are exposed to erosion and weathering, the permeability of the zone along the surface increases as does the fracture density of the rock, which in turn increases porosity. This is caused by a decrease in pressure on the rock formation when overlying material is removed by erosion. When the weathered surfaces are buried under new rock formations, the characteristics of permeability and porosity are preserved. If these zones can be located in the subsurface during drilling, they may be the areas best suited for ground water development. (Grober-NWWA)

W77-04133

W77-04291

## 8G. Materials

### PUMP HANDBOOK.

Worthington Pump Inc., Newark, N.J.  
McGraw-Hill, New York, N.Y. 1976. p 1102.  
\$34.50. Edited by I. J. Karassik, et. al.

Descriptors: \*Pumps, \*Hydraulic equipment, \*Pump testing, Performance, Quality control, Centrifugal pumps, Jets, Pistons, Turbines, Impellers, Intakes, Electric motors, Gears, Valves.

Identifiers: Pump classification, Similitude, Pump construction, Pump casings, Diffusers, Hydraulic balancing devices, Shafts, Shaft sleeves, Stuffing boxes, Mechanical seals, Bearings, Vertical pumps, Vacuum devices, Steam pumps, Screw pumps, Rotary pumps, Jet pumps, Motor controls, Steam turbines, Hydraulic turbines, Gas turbines, Eddy-current couplings, Electric drives, Fluid couplings, Pump controls, Monitoring instrumentation.

This handbook covers the theory, construction details, and performance characteristics of all the major types of pumps—centrifugal pumps, power pumps, steam pumps, screw and rotary pumps, jet pumps, and many of their variants. It deals with prime movers, couplings, controls, valves and the instruments used in pumping systems. Detailed treatment is given to the systems in which pumps operate and the characteristics of these systems. Because of the many services in which pumps have to be applied, a total of twenty-one different services—ranging from water supply, through steam power plants, construction, marine applications, and refrigeration to metering and solids pumping are examined and described in detail, again by a specialist in each case. The handbook provides information on the selection, purchasing, installation, operation, testing and maintenance of the various types of pumps. An appendix provides technical data useful in dealing with pumping equipment. (Heiss-NWWA)

W77-04114

### WELL LOGGING MANUAL.

Scientific Software Corp., Denver, Colo.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-247 641, Price codes: A99 in paper copy, A01 in microfiche. U.S. Geological Survey Manual, GS Contract Number 14-08-0001-13926, 1975. p 425, fig, tab, ref, append.

Descriptors: \*Logging(Recording), \*Subsurface investigations, \*Wells, \*Rock properties, \*Borehole geophysics, Geologic formations, Oil reservoirs, Stratigraphy, Porosity, Permeability, Pore pressure, Porous media, Boreholes, Radioactivity, Resistivity.

Identifiers: \*Well logging, Geophysical methods.

Well logging is the study and application of all borehole measurements to determine the properties of the geologic formations surrounding a borehole. Well logging plays an important role in both geology and engineering. A substantial number of applications are possible with the several dozen borehole measurement techniques available. The primary goal of well log analysis in this manual is the determination of volume of recoverable hydrocarbons by measurement of physical properties of rock which are related to the pore and fluid distribution. Over the past few years, considerable study has been made of rock properties such as porosity, permeability, capillary pressure, hydrocarbon saturation, fluid properties, electrical resistivity, self or natural potential and radioactivity of different types of rocks. The borehole evaluation methods covered are: cutting samples, coring, acoustic devices, radioactive devices, SP devices, resistivity devices, mud logging, production logging and dip meter devices. (Heiss-NWWA)

W77-04115

### FREE PUMP TESTS SAVE MILLIONS OF DOLLARS.

J. Schleicher.  
Johnson Drillers Journal, Vol. 48, No. 6, p 4-7, November-December, 1976. 3 fig.

Descriptors: \*Water well, \*Pump testing, Economic efficiency, Groundwater, Irrigation, California.

Identifiers: \*Pumping costs.

For the past 53 years, Pacific Gas and Electric Company has offered its customers a free pump testing service. The company estimates that over the lifetime of the program over \$11 million in power cost savings has been accrued. Irrigators do not receive the service automatically. They must submit a written application including all pertinent data on the well. The actual test requires an hour or less. A sounding line is used to measure both standing and pumping water levels and also take a temperature reading of the well water to gauge the depth. The inside diameter of the pump discharge pipe is then measured and as well as the velocity of discharge. The power input at the electric meter is then measured while the system is operating. The amperage and voltage at the switch panel are also checked to insure that incoming voltage is satisfactory. The power input to the motor is also determined. Using this information, plus power use records for that meter, the well drawdown reading and well output in terms of GPM are then calculated. These figures are computed with the current power usage at that particular site and the cost of pumping. If pumping efficiency is low, a comparative set of figures showing the rate of water production and pumping costs from a more efficient plant is prepared. These figures are then turned over to the operator with further any recommendations. About 15% of all pumps tested by the company each year indicate that they are in need of repair or adjustment. With the wide variety of temperatures and rainfall in California, there's no piece of equipment more important to an irrigating farmer than his pump. (Grober-NWWA)

W77-04118

### ENERGY COSTS DICTATE EFFICIENT WELL DESIGN.

For primary bibliographic entry see Field 8B.

W77-04119

### SHORT, LARGE DIAMETER SCREENS PROVE EFFECTIVE.

G. M. Erickson.

The Johnson Drillers Journal, Vol. 48, No. 6, p 3, November-December, 1976. 1 fig.

Descriptors: \*Water wells, \*Well screens, Lakes, Surface waters, \*New York.

Identifiers: \*Equal flow distribution, Southern Cayuga Lake Intermunicipal Water Commission(NY).

Through experience and laboratory experiments, Johnson engineers found that short, large diameter well screens generally provide a more equal flow-distribution, and were able to contribute to the completion of a large intake screen project for the Southern Cayuga Lake Intermunicipal Water Commission. The 50-year design requirements developed were: 24 mgd (16,670 gpm) with average water inlet velocities through the 1/4 inch screen openings not to exceed 0.3 fpm. The design selected was for two, 78 inch diameter, 5 ft. screens. It was necessary to build a number of smaller diameter screens, cut them longitudinally, flatten each screen section and re-roll the section to the proper radius. These smaller sections were then welded to form the single 78 inch diameter screens. These smaller diameter screens were manufactured with a special combination of wire and rod profiles so

## Field 8—ENGINEERING WORKS

### Group 8G—Materials

that the internal rods would provide the necessary rigidity and structural integrity. Various stiffening bars, brace flanges and support rings were used to give additional structural stability to the screen. The assembly was transported by barge and lowered into place by crane. The intake screens were attached to necessary pipe fittings and subsequently mounted on a steel base and support frame. The intake pipe is supported every 90 ft. by specially built platforms and anchored with piles. The water moves by gravity flow from the intake structure to the intake well in the raw-water pumping station. Three vertical turbine pumps raise the water from the intake well 100 ft. to a treatment plant. At present the facilities are being used at the initial design-rate of 6 mgd. (Grober-NWWA)  
W77-04120

**IMPROVED DRILLING IS A RESULT OF SOUND ENGINEERING.**  
West Engineering, Inc., Midland, Tex.  
E. R. West.  
World Oil, Vol. 183, No. 7, p 57-59, December, 1976. 2 fig, 1 tab.

Descriptors: \*Oil wells, \*Drilling, \*Project planning, Well casings, Drilling fluids, Pressure heads, Drilling equipment, Rock mechanics, Brines, Mud, Shales, Well logging.  
Identifiers: \*Problem anticipation planning, Drilling time, Drilling, Mud costs, Drill bits, Drilling problems.

The use of established engineering practices and proper planning resulted in the installation of the West Texas, Regan Trust 1 oil well in record time. Of the problems encountered, most were anticipated during planning. Most problems in similar deep wells in the area occurred in the high pressure Wolf camp, Atoka and Barrett sections. The problem sections are about 5,200 feet thick and required weighted mud to stabilize sloughing shale and contain high pressure gas. The well completed at the 21,650 foot level in 135 days, using 19 bits and incurring a mud bill of \$125,000. All of these parameters showed substantial improvement over other wells drilled in the area. (Heiss-NWWA)  
W77-04121

**LOW-COST CHEMICAL CUTS SAND PROBLEMS IN HEAVY OIL FIELD,**  
Getty Oil Co., Bakersfield, Calif.  
S. R. Charles.  
World Oil, Vol. 138, No. 7, December, 1976. p 61-62, 64, 3 fig, 3 ref.

Descriptors: \*Calcium hydroxide, \*Permeability, Migration, Silts, Stabilization, Clay minerals, Montmorillonite, Wells.  
Identifiers: \*Calcium aluminosilicates, \*Sand control, Thermal recovery operations, Kern River field(California).

The calcium hydroxide treatment process, tested in the Kern River field, California, is a sand control method that reduces sand movement. The treatment is relatively low-cost and material is effective at high temperatures. It consist of injecting an aqueous solution of calcium hydroxide into the producing sand. The chemicals react with fine particles and clay minerals, irreversibly altering them to a water insensitive state. Cementing materials formed during the chemical reactions bond the fines to larger formation particles preventing their migration and increasing matrix strength, without significantly reducing permeability. The process occur more rapidly at elevated temperatures and is well-suited to thermal recovery operations. The treatment is effective with solid string or liner completions, and should be performed in conjunction with steam injection. There were three treatment techniques used, and a total of 108 tests. The success of a treatment is based on improvement in a before-and-after comparison. Of the 108 calcium hydroxide treatments performed in the field, 70 of them have sufficient data to be evaluated. In 74%

of the cases evaluated, the amount of sand bailed after treatment was reduced. Footage of sand bailed decreased by 41% on the average for all treatments. This reduction is calculated between the four-month period directly preceding and directly following the treatment. At the end of additional four months, amount sand bailed decreased another 37%, which shows that the treated formation does not break down quickly with time. (Grober-NWWA)  
W77-04124

#### LUBRICATING WIRE ROPE.

Drilling - DCW, Vol. 38, No. 1, p 96, November, 1976. 2 fig.

Descriptors: \*Drilling equipment, \*Lubricants, \*Application methods.  
Identifiers: \*Wire rope, Metal-split-box, Pour-on method.

Proper lubrication techniques of wire rope, such as that used in drilling operations, will lengthen the service life of the rope considerably. When the rope is in use, only external application of lubricant is possible. The lubricant usually should be hot or warm to increase its penetration qualities. Lubricant penetration to the rope core is important so as to get coverage within the inner strands. Two popular methods of lubricant application are the metal-split-box and the pour-on methods. A lubricant engineer can suggest proper rope lubricant as well as amounts and frequency of application for a variety of ropes under various uses. (Heiss-NWWA)  
W77-04229

#### FIELD APPLICATION OF EXTERNALLY STRESS-RELIEVED DRILL COLLARS,

Shell Oil Co., Denver, Colo.  
L. A. Primm.

Drilling - DCW, Vol. 38, No. 1, p 85-88, November, 1976. 2 fig, 1 tab.

Descriptors: \*Drilling equipment, Rotary drilling, On-site tests, Design criteria, Specifications, Fabrication.

Identifiers: \*Externally stress-relieved drill collars, \*Connection failure.

The application of the externally stress relieved drill collar has reduced the connection fatigue failure rate of some drill collars being used in Shell Oil's Altamont well field in Utah. The application of the externally stress relieved drill collar may be more beneficial on new strings of drill collars which have a greater consistency of original structural properties than used assemblies. (Heiss-NWWA)  
W77-04130

#### SYSTEM PREVENTS LEACHATE FORMATION.

For primary bibliographic entry see Field 5G.  
W77-04136

#### SEGMENTAL ORIFICES WITH SHUNT METERS TO TOTALIZE PIPELINE FLOW,

Agricultural Research Service, Fort Collins, Colo.  
For primary bibliographic entry see Field 8B.  
W77-04269

#### SAMPLING: ONE KEY TO DRILLING SUCCESS,

Universal Oil Products, St. Paul, Minn. Johnson Div.

J. Carr.  
Water Well Journal, Vol. 30, No. 12, p 38-40, December, 1976.

Descriptors: \*Sampling, \*Geologic formations, \*Water wells, Drilling equipment, Heaving, Clays, Silts.

Identifiers: \*Rotary drilling, \*Cable tool drilling.

Drillers collect samples to provide the most accurate picture possible of an underground situation. These samples must typify and be descriptive of the rest of the formation. Good samples are essential for proper well design, and consequently the optimum well efficiency can be achieved with less development time. A driller must be aware of the variations in the aquifer to determine the frequency of sampling. The manner in which the sample is collected and the tools used depend on the type of equipment used to drill the hole. When obtaining a sample in rotary drilling, the drilling should be stopped and circulation continued until the fluid is clean. This insures that the sample collected will not contain any residue or cuttings from formations higher up the hole. In cable tool drilling, with the proper equipment and care, near perfect samples can be obtained. Shavings or peelings of the wall are cut off by the driving and these shavings represent a true picture of the material being sampled. Once the samples have been collected they should be containerized and labeled. It can be helpful to lay samples out at the job site in the sequence that they have been encountered so some evaluation and comparison can be made right there. In labeling the sample, the well name or number should be given along with the diameter and the static water level of the aquifer. The most important part of the label is a description of the depth from which the sample was taken. In describing the material, it is standard practice to list the most permanent constituents first. (Grober-NWWA)  
W77-04279

#### DON'T LET THE BUGS GET THE BEST OF YOU,

National Water Well Association, Worthington, Ohio.

T. E. Gass.

Water Well Journal, Vol. 32, No. 1, p 26-27, January, 1977.

Descriptors: \*Water wells, \*Groundwater, \*Disinfection, \*Iron bacteria, \*Pathogenic bacteria, Coliform bacteria, Chlorination.

Identifiers: \*Encrustation, \*Clogging, Sulphate-reducing bacteria, Nitrate-reducing bacteria.

Many microscopic organisms exist in ground water. These organisms corrode steel casings, clog screen openings, and cause disease. Although there are hundreds of different types of bacteria, only a select few are of importance to the water well contractor. Iron bacteria, sulfite-reducing bacteria, nitrate-reducing bacteria and certain pathogenic organisms are those of primary concern. Organisms such as these are commonly introduced into ground water by poorly located animal feedlots, septic tanks, improperly designed water wells, sewer lines and landfill sites. Coliform bacteria, when present in water, is taken as evidence that the water is polluted by either human or animal waste. The reduction or elimination of problems caused bacterial organisms in water well can be accomplished by means of disinfection procedures integrated with the well drilling process. A solution of 100 parts per million of chlorine will serve as a suitable disinfection agent. Disinfection should begin with treatment of the drilling tools before beginning each new job. Consequent disinfection of the completed well, gravel pack, pump and plumbing should be the last operations performed by the contractor before leaving the site. (Heiss-NWWA)  
W77-04281

#### A LIGHT IN THE WATER.

Ground Water Age, Vol. 11, No. 5, p 18-20, January, 1977. 4 fig.

Descriptors: \*Remote sensing, \*Electronic equipment, \*Water wells, \*Inspection, Well casings, Pipes, On-site investigations.

Identifiers: \*Borehole television cameras, Photographic logging.

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## ENGINEERING WORKS—Field 8

### Fisheries Engineering—Group 8I

Borehole television cameras are relatively new and extremely useful. The TV systems are used for inspection of installed well casings, well screens, well casing welds or any other 'downhole' problems. Sophisticated television equipment can ferret out the trouble spots permitting an equally sophisticated diagnosis of the problem. A television inspection of Williams Air Force Base water wells showed excessive encrustation. Because of this condition the base has established a policy of periodic television inspection whenever the pump is pulled. The Air Force has also initiated well casing inspection regulations which require downhole television systems. The Arizona state water commission and the state land department are taking a stronger position on water quality. Both are requiring detailed reports on underground conditions and well design and are expected to insist on photographic logging in the near future. This trend has so far been limited to industrial and city wells, but agricultural irrigation wells are expected to be involved soon. (Heiss-NWWA)  
W77-04282

**SUPERHARD MATERIALS PROMISE EXTENDED WEAR CAPABILITY,**  
Sabre Drill Bits, Inc., Philadelphia, Pa.  
D. R. Sabre.  
World Oil, Vol. 184, No. 1, p 109-112, January, 1977. 7 fig.

Descriptors: \*Metals, \*Physical properties, \*Mechanical properties, Drilling equipment, Laboratory tests, Failure(Mechanics).  
Identifiers: \*Superhard materials, Boron carbide, Titanium diboride, Silicon carbide, Silicon nitride, Rotary drill bits, Stabilizers.

Superhard materials, ranging in hardness between that of tungsten carbide and diamonds, are being evaluated for use as cutting elements in drill bits and as wear surfaces on stabilizers. Compounds considered potentially useful for drilling applications include boron carbide, titanium diboride, silicon carbide and silicon nitride. Mixtures of boron carbide and titanium diboride have exhibited unusual qualities and exceed wear resistance of the parent compounds in some applications. In the present condition superhard materials should serve well in drill bits. A 40 percent improvement should take place in the near future when efforts will be directed to specific compositions of the materials. (Heiss-NWWA)  
W77-04283

**A STUDY OF TUBEWELL INSTALLATIONS IN BETUL DISTRICT MADHYA PRADESH, INDIA,**  
E. L. C. Water Development Project, Betul (India).  
For primary bibliographic entry see Field 8B.  
W77-04284

**COLLARS WITH ER GROOVES HAD FEWER CONNECTION FAILURES,**  
Shell Oil Co., Ventura, Calif.  
L. A. Primm.  
World Oil, Vol. 184, No. 1, p 87-89, January, 1977. 2 fig, 1 tab.

Descriptors: \*Drilling equipment, Fatigue(Mechanics), Failure(Mechanics), Stress, Testing, Drilling.  
Identifiers: \*Externally stress-relieved drill collars, Connection fatigue, Drill collar flexure, Altamont field(Utah).

The use of externally stress-relieved drill collars was helpful in reducing connection fatigue failure rates for drill collars during a year of drilling in Utah's Altamont field. Recent work has shown that drill collar connector fatigue life can be increased if external grooves are cut in the body of the collar near the connector. Conceptually, the grooves distribute the bend associated with collar

flexure away from the threaded connection, thus lowering the cyclic stress level in the connection. Results from applying the externally stress relieved drill collar feature have been favorable in reducing the connection fatigue failure rates of some drill collars at Altamont. Where difficulties were encountered it was found that failure was due to one collar size and one type of connector. There was a probability that the connection failures were induced by machine shop practices when these connectors were cut. The application of the externally relieved feature maybe more beneficial on new strings of drill collars which have a greater consistency of properties that used assemblies. (Heiss-NWWA)  
W77-04285

**ARTIC CASING PACK,**  
L. J. Remont, and M. J. Nevins.  
Drilling - DCW, Vol. 38, No. 1, p 43-45, November, 1976. 2 fig, 2 tab. Reprinted from Vol. 27, No. 1, of the Baroid News Bulletin.

Descriptors: \*Thermal insulation, \*Boreholes, \*Freezing, \*Frost action, \*Permafrost, Freeze-thaw tests, Casings, Oil wells, Gels, Heat transfer, Artic, Ice, Soil mechanics, Laboratory tests, Alaskan North Slope.  
Identifiers: \*Thermal casing insulation, Artic oil wells.

An artic casing pack which has been designed by Baroid is helping to overcome production problems on Alaska's North Slope. The most common problems are stress on the downhole tubular goods due to reported freezing and thawing, and weakening of the casing support due to melting of the permafrost once oil production has begun. Oil production itself is also affected by the permafrost zone. Subsidence of the earth and damage to the casing and tubing can result unless some form of thermal insulator is used. Baroid has designed an Artic Casing Pack that effectively removes water and water base muds and minimizes convective heat transfer to the permafrost. The casing pack is essentially low water content oil mud that uniquely gels to a greaselike consistency when heated. The gelled pack provides an effective thermal barrier since it remains gelled even at a temperature of 170 degrees Fahrenheit. (Heiss-NWWA)  
W77-04286

**SPARKLE PLENTY,**  
Drilling - DCW, Vol. 38, No. 2, p 61, December, 1976. 3 fig.

Descriptors: \*Drilling equipment, \*Rotary drilling, Drilling fluids.  
Identifiers: \*Diamond drilling bits, Tooth design, Mud weights, Rotary table speeds, Bit weights, Pressure drops.

A twenty-six inch, one-piece diamond, rotary drill bit was recently fabricated at the American Coldset Corporation in Dallas, Texas. The bit was flown to the Iranian oil fields for evaluation testing. The 3,800 pound version of American Coldset Corporation's Shank Tooth design incorporates thousands of Congo cube diamonds, each weighing in the range of one carat. The bit was designed for fluid volumes in the range of 1000 to 1400 gallons per minute, mud weights in the range of 8.3 to 10.5 pounds per gallon, table speeds of 100 to 250 revolutions per minute, bit weights of 80,000 to 100,000 pounds and pressure drops of 700 to 1000 pounds per square inch. If performance data shows promise, a trial of a thirty-six inch version will probably be scheduled.  
W77-04287

**GOOD PLANNING IS THE KEY TO DEVIATION CONTROL,**  
Texas Pacific Oil Co., Clagary (Canada).  
For primary bibliographic entry see Field 8C.  
W77-04289

**SECOND TEST DRILLING PROGRAM BEGUN TO SUPPORT RGREP.**  
Water for Texas, Vol. 6, No. 7, p 20 July-December, 1976. 1 fig.

Descriptors: \*Subsurface investigations, \*Logging(Recording), \*Drilling, Observation wells, Sampling, Water sources, Saline water, Water level fluctuations, \*Texas, \*Rio Grande River.

Identifiers: \*Test hole wells, \*Drilling program, \*Freshwater exploration, Rio Grande River, El Paso Valley.

The Texas Water Development Board began a testhole drilling program in cooperation with the Rio Grande Regional Environmental Project (RGREP), a project of the U.S. Bureau of Reclamation. The test holes are being drilled in an effort to locate fresh water within the Hueco Bolson deposits of the El Paso Valley. Additional water is needed by the local water improvement district for supplemental irrigation purposes during periods of inadequate surface water allotments from the Rio Grande River. Three test holes have been sunk to date yielding only salt water. This is the second test hole drilling program conducted since 1973. When completed all test holes will be completed as permanent observation wells to monitor changes in water levels resulting from pumping in Mexico. (Heiss-NWWA)  
W77-04290

### 8I. Fisheries Engineering

**SURVIVAL OF COHO SALMON FINGERLINGS PASSING THROUGH OPERATING TURBINES WITH AND WITHOUT PERFORATED BULKHEADS AND OF STEELHEAD TROUT FINGERLINGS PASSING THROUGH SPILLWAYS WITH AND WITHOUT A FLOW DEFLECTOR,**  
National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.  
For primary bibliographic entry see Field 5C.  
W77-04402

**EVALUATION OF FISH PROTECTIVE FACILITIES AT LITTLE GOOSE AND LOWER GRANITE DAMS AND REVIEW OF OTHER STUDIES RELATING TO PROTECTION OF JUVENILE SALMONIDS IN THE COLUMBIA AND SNAKE RIVERS, 1975,**  
National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.  
For primary bibliographic entry see Field 5C.  
W77-04404

**SURVIVAL OF COHO SALMON FINGERLINGS PASSING THROUGH A PERFORATED BULKHEAD IN AN EMPTY TURBINE BAY AND THROUGH FLOW DEFLECTORS (WITH AND WITHOUT DENTATES) ON SPILLWAY AT LOWER MONUMENTAL DAM, SNAKE RIVER, APRIL-MAY, 1973,**  
National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.  
For primary bibliographic entry see Field 5C.  
W77-04405

**SURVIVAL OF FINGERLING PASSING THROUGH A PERFORATED BULKHEAD AND MODIFIED SPILLWAY AT LOWER MONUMENTAL DAM, APRIL-MAY, 1972,**  
National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center.  
For primary bibliographic entry see Field 5C.  
W77-04406

**THE EFFECTS OF GAS SUPERSATURATION ON COLUMBIA RIVER FISH RUNS - APPENDIX G,**  
Army Engineer Div. North Pacific, Portland, Ore.

## Field 8—ENGINEERING WORKS

### Group 81—Fisheries Engineering

For primary bibliographic entry see Field 5C.  
W77-04412

**GAS BUBBLE DISEASE, PROCEEDINGS OF A WORKSHOP HELD AT RICHLAND, WASHINGTON, OCT. 8-9, 1974.**  
 Battelle-Pacific Northwest Labs, Richland, Wash.  
 For primary bibliographic entry see Field 5C.  
 W77-04413

**BIOLOGICAL STUDIES: FIELD ORIENTATION,**  
 National Marine Fisheries Service, Seattle, Wash.  
 For primary bibliographic entry see Field 5C.  
 W77-04433

**THE EARLY LIFE HISTORY OF FISH, VOLUME II.**  
 For primary bibliographic entry see Field 21.  
 W77-04524

**NUTRITION DE LA LARVE DE TURBOT (SCOPHTHALMUS MAXIMUS L.) AVANT LA METAMORPHOSE,**  
 Centre Oceanologique de Bretagne, Brest (France).  
 For primary bibliographic entry see Field 5C.  
 W77-04526

**PROGRESS TOWARDS THE DEVELOPMENT OF A SUCCESSFUL REARING TECHNIQUE FOR LARVAE OF THE TURBOT, SCOPHTHALMUS MAXIMUS L.**  
 Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.  
 For primary bibliographic entry see Field 21.  
 W77-04527

**LABORATORY REARING OF COMMON SOLE (SOLEA SOLEA L.) UNDER CONTROLLED CONDITIONS AT HIGH DENSITY WITH LOW MORTALITY,**  
 Bayerische Landesanstalt fuer Fischerei, Starnberg (West Germany).  
 For primary bibliographic entry see Field 5C.  
 W77-04528

**EARLY LIFE HISTORY OF LIMANDA YOKOHAMAE (GUNTHER),**  
 Tohoku Regional Fisheries Research Lab., Shiogama (Japan).  
 For primary bibliographic entry see Field 21.  
 W77-04533

**EFFECT OF HYDROGEN SULFIDE ON DEVELOPMENT AND SURVIVAL OF EIGHT FRESHWATER FISH SPECIES,**  
 Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.  
 For primary bibliographic entry see Field 5C.  
 W77-04552

**EFFECTS OF THERMAL SHOCK ON LARVAL ESTUARINE FISH—ECOLOGICAL IMPLICATIONS WITH RESPECT TO ENTRAINMENT IN POWER PLANT COOLING SYSTEMS,**  
 National Marine Fisheries Service, Beaufort, N.C. Atlantic Estuarine Fisheries Center.  
 For primary bibliographic entry see Field 5C.  
 W77-04556

## 10. SCIENTIFIC AND TECHNICAL INFORMATION

### 10B. Reference and Retrieval

**WATER RESOURCES RESEARCH IN THE LOWER COLORADO RIVER BASIN, 1972-1976,**  
 Nevada Univ., Reno. Desert Research Inst.  
 For primary bibliographic entry see Field 4A.  
 W77-04148

### 10C. Secondary Publication And Distribution

**ESTUARINE POLLUTION, A BIBLIOGRAPHY, VOLUME 2.**  
 Office of Water Research and Technology, Washington, D.C.  
 For primary bibliographic entry see Field 5B.  
 W77-04109

**ESTUARINE POLLUTION, A BIBLIOGRAPHY, VOLUME 3.**  
 Office of Water Research and Technology, Washington, D.C.  
 For primary bibliographic entry see Field 5B.  
 W77-04110

**ALGAE ABSTRACTS, A GUIDE TO THE LITERATURE, VOLUME 3, 1972-1974.**  
 Office of Water Research and Technology, Washington, D.C. Water Resources Scientific Information Center.  
 For primary bibliographic entry see Field 5C.  
 W77-04111

**WATER RESOURCES RESEARCH IN THE LOWER COLORADO RIVER BASIN, 1972-1976,**  
 Nevada Univ., Reno. Desert Research Inst.  
 For primary bibliographic entry see Field 4A.  
 W77-04148

**RESOURCE AND LITERATURE REVIEW, DIS-SOLVED GAS SUPERSATURATION AND GAS BUBBLE DISEASE, 1975,**  
 Parametrix, Inc., Bellevue, Wash. Environmental Services Section.  
 For primary bibliographic entry see Field 5C.  
 W77-04437

**RESOURCE AND LITERATURE REVIEW, DIS-SOLVED GAS SUPERSATURATION AND GAS BUBBLE DISEASE,**  
 Parametrix, Inc., Bellevue, Wash. Environmental Services Section.  
 For primary bibliographic entry see Field 5C.  
 W77-04438

### 10D. Specialized Information Center Services

**IDENTIFICATION CODES FOR ORGANIZATIONS LISTED IN COMPUTERIZED DATA SYSTEMS OF THE U.S. GEOLOGICAL SURVEY,**  
 Geological Survey, Reston, Va. Water Resources Div.  
 For primary bibliographic entry see Field 7A.  
 W77-04224

**DIRECTORY OF LOCAL ASSISTANCE CENTERS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),**  
 Geological Survey, Reston, Va. Water Resources Div.  
 For primary bibliographic entry see Field 7C.

W77-04225

**STATUS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX)—SEPTEMBER 1976,**  
 Geological Survey, Reston, Va. Water Resources Div.  
 For primary bibliographic entry see Field 7C.  
 W77-04237

### 10F. Preparation Of Reviews

**WATER RESOURCES TECHNOLOGY TRANSFER - A GUIDE,**  
 Universities Council of Water Resources, Lincoln, Nebr. Technology Transfer Committee.  
 W. E. Sharpe, R. R. Huffsey, W. R. Kerns, J. M. Stewart, and J. C. Dyer.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 704, Price codes: A03 in paper copy, A01 in microfiche. Pennsylvania Institute for Research on Land and Water Resources, University Park, January 1977. 24 p. 2 fig. 15 ref. OWRT T-0003(No. 6702)(1).

**Descriptors:** \*Evaluation, Publications, Information exchange, Communication, Conferences, Manuals, Films, Radio communication systems, Information retrieval, Water resources institute.  
**Identifiers:** Technology transfer, \*Literature reviews, \*Communication media, \*Model institute program, \*Personal contact, Recommendations, News releases, Public service television, Newsletters, Video tape, Displays, Exhibits, Trade journals, Bulletins, Seminars, Short courses.

This guide is intended to provide an explicit definition of technology transfer and establishes the philosophy and recommended procedures for conducting technology transfer programs. From literature reviews and proven water center experiences with technology transfer, effective and appropriate communication media are listed and described. Techniques included are: news releases, public service television, radio programming, newsletters, films and video tapes, displays and exhibits, trade journals and organizational publications, pamphlets, brochures and bulletins, manuals, seminars, short courses and conferences, and personal contact. Personal contact is described as the most essential ingredient in any technology transfer program. The guide describes the how-to of developing a technology transfer program, gives evaluation methods for such programs, outlines a model institute program, and offers eleven recommendations to fulfill the technology transfer mandates of the 1971 Amendments to the Water Resources Research Act (Sink-Penn State) W77-04226

**RESOURCE AND LITERATURE REVIEW, DIS-SOLVED GAS SUPERSATURATION AND GAS BUBBLE DISEASE, 1975,**  
 Parametrix, Inc., Bellevue, Wash. Environmental Services Section.  
 For primary bibliographic entry see Field 05C.  
 W77-04437

**RESOURCE AND LITERATURE REVIEW, DIS-SOLVED GAS SUPERSATURATION AND GAS BUBBLE DISEASE,**  
 Parametrix, Inc., Bellevue, Wash. Environmental Services Section.  
 For primary bibliographic entry see Field 05C.  
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W77-04475	5B	W77-04554	5C		
W77-04476	5B	W77-04555	5C		
W77-04477	6G	W77-04556	5C		
W77-04478	2L	W77-04557	5G		
W77-04479	6B	W77-04558	5D		
W77-04480	6B	W77-04559	2L		
W77-04481	6B	W77-04560	5A		
W77-04482	2L	W77-04561	5G		
W77-04483	2L	W77-04562	6B		
W77-04484	6G	W77-04563	6F		
W77-04485	6B	W77-04564	5G		
W77-04486	6B	W77-04565	6C		
W77-04487	2L	W77-04566	3C		
W77-04488	2L	W77-04567	5G		
W77-04489	5G	W77-04568	5C		
W77-04490	5G	W77-04569	5C		
W77-04491	5B	W77-04570	5G		

## ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
<b>A. CENTERS OF COMPETENCE</b>		
Cornell University, Policy Models for Water Resources Systems	W77-04493--04507 04523	16
ERDA Oak Ridge National Laboratory, Nuclear Radiation and Safety	W77-04508--04522 04524--04556	48
Franklin Institute (FIRL), Municipal and Industrial Wastewater Treatment Technology	W77-04445--04461	17
Illinois State Water Survey, Hydrology	W77-04247--04260 04262--04277	30
National Water Well Association, Water Well Construction Technology	W77-04113--04136 04139--04140 04279--04293	41
University of Arizona, Arid Land Water Resources	W77-04311--04324	14
University of Florida, Eastern U. S. Water Law	W77-04347--04386	40
University of North Carolina, Metropolitan Water Resources Planning and Management	W77-04204--04206 04209--04220 04246	16
University of Wisconsin, Eutrophication	W77-04149--04166 04568--04578	29
University of Wisconsin, Water Resources Economics	W77-04167--04171 04557--04559 04561--04567	15
<b>B. STATE WATER RESOURCES RESEARCH INSTITUTES</b>		41
	W77-04101--04108 04141--04144 04174--04181 04294--04298 04325--04327 04387--04399	

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SOURCE	ACCESSION NUMBER	TOTAL
<b>C. OTHER</b>		
BioSciences Information Service	W77-04137--04138 04183 04207--04208 04261, 04278 04334, 04337 04407, 04560 04579--04600	33
Bureau of Reclamation	W77-04112	1
Biological Consultant and Information Services (Effects of Pollutants on Aquatic Life)	W77-04328--04333 04335--04336 04338--04345	16
Biological Consultant and Information Services (Gas Bubble Disease)	W77-04400--04406 04408--04444	44
National Commission on Water Quality	W77-04299--04310	12
National Oceanic and Atmospheric Administration	W77-04184--04201	18
Ocean Engineering Information Service (Outer Continental Shelf)	W77-04462--04492	31
Office of Water Research and Technology	W77-04109--04111 04145--04148 04182 04202--04203 04346	11
U. S. Geological Survey	W77-04221--04245	25

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